March 1960

EDITORIAL

ONE of the fortunate aspects of the radio and electrical trade in Australia is its continuity and resilience. Despite the many gloomy observations that have been made over the years that "the game is finished," the industry as a whole continues to expand and mature.

Many of us will remember its virtual birth in the 1930 era, when radio receivers emerged from the clumsy-technical-gadget stage to a packaged household item, which everyone wanted and anyone could operate. Many of the big names in radio and the whole concept of dealers and servicemen date from that time.

During the following years, when it seemed that the market must surely saturate, it received vital "shots in the arm" from a general interest in short-wave listening, from radiogram sales and from the "second set" idea.

After the war, there was a renewed replacement demand for receivers of all types, leading into the development of microgroove records and equipment on which to play them.

But, during those same years, the old traditional "ice chest" was being displaced by household refrigerators and many factories and concerns, which might otherwise have had a lean time, made and sold them in huge numbers.

Then, of course, television came to N.S.W. and Victoria and later to the other capitals, with country centres still to follow. Unprecedented amounts have been spent—and will be spent—by the public on television, with the industry ever growing to keep pace with the demand.

Some have suggested that the coming winter season will be the biggest ever in radio, television and electrical appliances.

As if that is not enough, a new and very profitable field looks like opening up in the near future. I refer to air conditioning in private homes.

During the recent heat-wave in the Sydney area, an extraordinary number of people seemed to be discussing the need for such equipment. I lost count of the number who mentioned the possibility of building their own. The residents of Sydney, and probably Melbourne as well, are all set for air conditioning and, once the rush starts, it will become nationwide.

And I must confess that, on many of the hot nights, I've tossed sleeplessly on the bed and wished only for a breath of cool air, cost what it might!

Maybe our pioneering forefathers had to put up with the heat and humidity but, that doesn't mean that they enjoyed it. And it doesn't mean, either, that they would not have queued up, money in hand, if they could have bought relief, as we now have the opportunity of doing.

W. M. Williams

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RADIO TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Operating from a small jungle clearing, this RAF helicopter provides essential transport for members of A Company, First Battalion, Royal Australian Regiment. Troops relieved British Company in "Operation Bamboo" in Malaya.

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for fast accurate alignment

FEATURES

- Extremely high stability
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- Internal 50 cycle frequency modulation.
- Sweep width of 0-25 Mc/s continuously variable.
- Built-in Crystal Oscillator.
- Marker Oscillator 25-55 Mc/s calibrated harmonics up to 220 Mc/s.

£120 plus S.T. 12½%.

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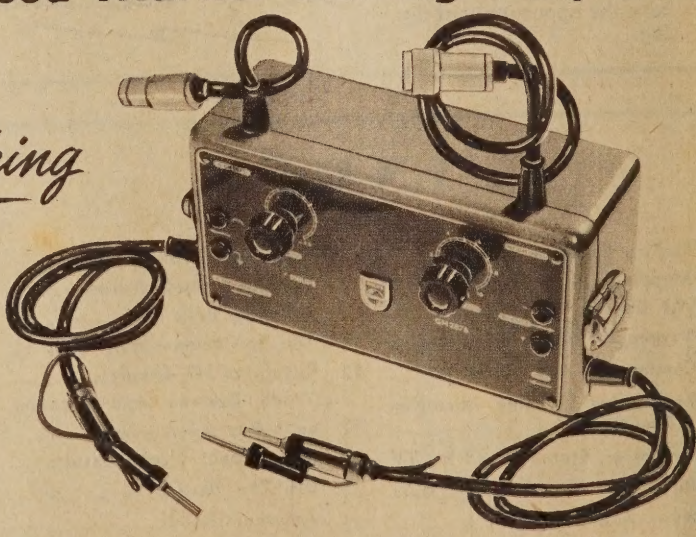

The combination of the GM 2876 with the GM 2875 Sweep and Marker Generator permits an amplification of the frequency marker the size of which is independent of its position on the frequency response curve.

FEATURES

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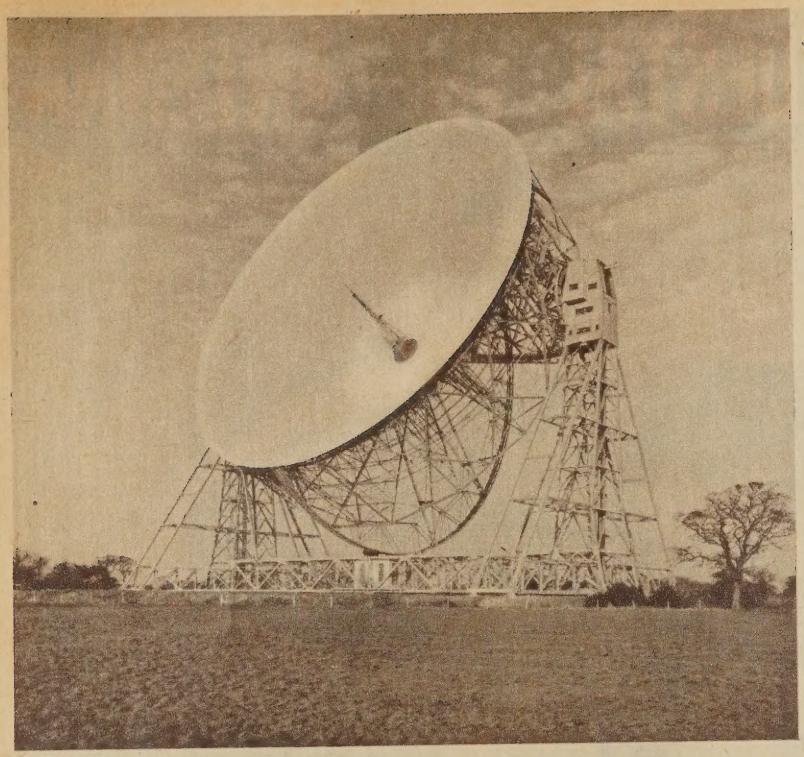
15-TON PEDESTAL VHF ANTENNA

Towering above Philco's Western Development Laboratories is the world's largest pedestal antenna. Built for U.S. Air Force for reception of telemetered information and data from satellites and missiles in any phase of their flight, the 60-ft. reflector, weighing 15 tons, is mounted atop a 50-ft. pedestal. Destined for a remote satellite tracking station, the antenna is largest in world to employ tri-axial mounting-movement in three directions, much like a man's wrist or forearm.



Constructed to the design of the radio-astronomy department of Manchester University, Jodrell Bank is the world's largest fully steerable radio telescope. It can receive and record radio waves originating in outer space at distances of up to 1000 million light years.

Mapping Outer Space From Jodrell Bank

Overshadowed by the bowl and structure of the world's largest steerable radio telescope, the working site of Jodrell Bank Experimental Station resembles a village green surrounded by the strange shapes of the aerial tubes, wires and rods that are the esoteric tools of radio astronomy.

By KENNETH OWEN*

FRINGING the green also are the modest huts in which Manchester University scientists have devised experiments, built equipment and interpreted results leading to a wide basic knowledge of the universe.

Almost incidentally, these men are now in the satellite and space-probe business.

Director of the station and Professor of Radio Astronomy at the university is Alfred Charles Bernard Lovell, O.B.E., F.R.S., who conceived the idea of the big steerable instrument in 1947.

VITAL SUPPORT

Support in the construction of the instrument was received by the university from the Department of Scientific and Industrial Research and from the Nuffield Foundation.

Ten years later, there was a new landmark in the Cheshire countryside and the telescope entered service.

The science of radio astronomy has shown that there is much more in the universe than the eye can see, even when helped by the largest optical telescopes.

Light waves from the stars are obscured in their passage to Earth by interstellar dust and gas, by dust and cloud in the earth's atmosphere, and by daylight.

Radio waves, whose wavelengths are millions of times longer than light waves, can be received unhampered by cloud, dust or daylight, and radio telescopes can study a much greater volume of space than is accessible to any optical telescope.

The signals received, apart from electromagnetic radiation from the sun, comprise a general radio "brightness" which is maximum in the plane of the galaxy, and signals from a number of discrete sources of small angular diameter.

There are two ways of improving the range at which signals can be received and also the sharpness of focus, or resolution: (1) simply by increasing the area of the reflector, and (2) by using two spaced aerials as an interferometer.

At Jodrell Bank both methods had been used prior to the construction of the big steerable instrument.

A 218ft reflector, in appearance rather like a wide saucer of wire netting, was (and still is) used, but this is a simple transit type which is fixed to the ground and is not steerable.

On occasion, the 218ft and the 250ft instruments are used together in interferometric techniques.

The construction of the 250ft radio telescope was the most significant step forward in the history of Jodrell Bank, and the value of its later applications to the tracking of artificial satellites and space probes is now well known.

IMMENSE PROBLEMS

The engineering problems involved in such a construction project were immense.

The main reflector bowl is a paraboloid 250ft in diameter, made of welded steel plates and supported in a lattice steel cradle. Radio waves received by the bowl are reflected and concentrated at the focus of the paraboloid, and a 62½ft steel tower at the centre of the bowl is used to mount the aerial at this focus position.

The bowl and cradle assembly weighs about 800 tons and is carried by roller bearings in trunnions at the top of the two 185ft side towers.

Suspended beneath the centre of the bowl is a "swinging" laboratory which contains part of the main amplification system for incoming radio signals, and the entire bowl and cradle assembly is damped against swaying, flutter and vibration by the prominent "bicycle wheel" circular stabilising girder.

The entire supporting structure comprising the towers and a horizontal lattice girder rotates in azimuth, with six roller-bogies at the base of each tower running on a double circular-rail track of 352ft outer diameter.

SELECTING FREQUENCIES

By changing the aerial mounted at the focus, the frequency of the instrument can be altered and, for radar use, transmitters can be housed in extra laboratory space at the tops of the supporting towers.

In October, 1957, as the final touches were being made to the new radio telescope, came the amazing news of the launching by the Soviet Union of the first artificial Earth satellite.

★ By arrangement with "FLIGHT."

SATELLITES AND PROBES—A QUICK REFERENCE

Satellite	Launching vehicle	Date launched	Expiry or lifetime	Shape	Payload (lb)	Incln. (deg)	Orbit (miles)	Period (min)	Experiments	Radio (Mc/s)	Remarks
Sputnik 1 (U.S.S.R.)	undisclosed	Oct. 4, 1957	Jan. 4, 1958	sphere	184	65	142-588	96.17	internal temp., press.	20.005 40.002	batteries stopped Oct. 27, 1957
Sputnik 2 (U.S.S.R.)	undisclosed	Nov. 3, 1957	Apl. 14, 1958	complex	1,120	65	140-1,038	103.7	cosmic rays, solar u-v. and X-rays, test animal (dog Laika) temp., press.	20.005 40.002	batteries stopped Nov. 10, 1957; satellite acceln. led to discovery of solar influence on upper-atmos. density
Explorer 1 (U.S.A.)	Jupiter C	Jan. 31, 1958	3-5 yr est.	cylinder	30.8 (18.13)	33.34	224-1,573	114.8	cosmic rays, micrometeorites, internal and shell temps.	108 108.03	discovery of first Van Allen radiation belt
Vanguard 1 (U.S.A.)	Vanguard	Mar. 17, 1958	200 yr est.	sphere	3.25	34.25	409-2,453	133.7	temps., geodetic data	108 108.03	mercury batteries stopped Apl. 5, 1958; solar batteries should power radio indefinitely
Explorer 3 (U.S.A.)	Jupiter C	Mar. 26, 1958	June 27, 1958	cylinder	31 (18.56)	33.4	121-1,746	115.87	cosmic rays, micrometeorites, internal and skin temps.	108 108.03	data on Van Allen belt, micrometeorite impacts
Sputnik 3 (U.S.S.R.)	undisclosed	May 15, 1958	19 mths est.	conical	2,925	65.3	135-1,167	105.95	atmos. press. and composition, positive ions, electrostatic charge and field, Earth's magnetic field, solar corpuscular radiation, cosmic rays, micrometeors, temps.	20.005 40.01	chemical and solar batteries
Explorer 4 (U.S.A.)	Jupiter C	July 26, 1958	1 yr est.	cylinder	38.4 (25.8)	50.29	163-1,380	110.27	corpuscular radiation, internal temp.	108 108.03	radiation belt data
Project Score (U.S.A.)	Atlas	Dec. 18, 1958	Jan. 21, 1959	Atlas shell	8,750 (150)	32.3	110-920	101.46	radio transmit, record and receiving apparatus	132.435 132.905 107.97 107.94	satellite received, recorded and re-transmitted voice messages from ground stations
Vanguard 2 (U.S.A.)	Vanguard	Feb. 17, 1959	10 yr est.	sphere	20.74	32.88	347-2,064	125.85	cloud cover by photocells	108 108.03	instrumentation functioned, but satellite's wobbling motion made data interpretation difficult
Discoverer 1 (U.S.A.)	Thor-Hustler	Feb. 28, 1959	Mar. 5, 1959	cylinder	1,300 (245)	87	99-605	95.9	checkout of propulsion, guidance, staging, communications	classified	stabilization difficulty hampered tracking
Discoverer 2 (U.S.A.)	Thor-Hustler	Apl. 13, 1959	Apl. 26, 1959	cylinder	1,610 (245)	89.8	142-220	90.5	capsule re-entry and recovery	classified	capsule ejection timer malfunction caused capsule impact near Spitzbergen instead of Hawaii on Apl. 14
Explorer 6 (U.S.A.)	Thor-Able 3	Aug. 7, 1959	1 yr est.	spheroid	142	48	157-26,400	766	high-, medium- and low-level radiation, micrometeorites, magnetic field, facsimile scanner, radio propagation, internal and surface temp. measurement, internal temp. control, solar cells	108.06 108.09 undisclosed UHF	digital telemetry stores data, transmits on ground command; four 20in × 20in solar-cell vanes for battery charging; auxiliary 5 lb thrust solid rocket carried but unused
Discoverer 5 (U.S.A.)	Thor-Hustler	Aug. 13, 1959	1 month est.	cylinder	1,700 (300)	appx. 90	136-450	94	capsule re-entry and recovery	classified	capsule ejected but not located following "malfunction of sequencing telemetry signals"
Discoverer 6 (U.S.A.)	Thor-Hustler	Aug. 19, 1959	1 month est.	cylinder	1,700 (300)	appx. 90	200-500	95	capsule re-entry and recovery	classified	capsule ejected but not located

MAIN DETAILS of all the successful artificial Earth satellites and space probes launched up to August 21, 1959 are presented in these two tables, which have been compiled from official U.S. and Soviet sources. The "orbit" column lists the initial perigee and apogee, and the period quoted is the initial period of the satellite.

The payload quoted is normally the total weight of the object concerned, with the weight of scientific equipment given in parentheses where known. Designation of the Mechta launching vehicle is unofficial. Launchings up to the end of 1958 formed part of International Geophysical Year activity; current U.S. launchings are by the National Aeronautics and Space Administration (Vanguard, Explorer, Pioneer) and the Advanced Research Projects Agency of the Department of Defense (Discoverer).

Probe	Launching vehicle	Date	Expiry or lifetime	Shape	Payload (lb)	Distance (miles)	Experiments	Radio (Mc/s)	Remarks
Pioneer 1 (U.S.A.) lunar probe	Thor-Able 1	Oct. 11, 1958	43 hr 17.5 min	toroidal	84.4 (39)	70,700	radiation, magnetic fields of Earth and Moon, micrometeor density, internal temp., electronic scanner	108.06	determined radial extent of radiation band, mapped ionizing flux, observed hydromagnetic oscillations of Earth's magnetic field, discovered magnetic field discrepancy with theory, determined micrometeor density and measured interplanetary magnetic field
Pioneer 2 (U.S.A.) lunar probe	Thor-Able 1	Nov. 8, 1958	42.4 min	toroidal	86.4 (34.3)	963	total ionizing radiation, cosmic ray flux, others as Pioneer 1	108.06 108.09	third stage failed to ignite; probe obtained data on flux, radiation, micrometeor density
Pioneer 3 (U.S.A.) space probe	Juno 2	Dec. 6, 1958	38 hr 6 min	conical	12.95	63,580	measurement of radiation in space	960.05	discovered second radiation belt; designed velocity, 24,897 m.p.h.; attained velocity, about 24,000 m.p.h.
Mechta or Lunik (U.S.S.R.) space probe	T-3	Jan. 2, 1959	indefinite	spherical	3,245 (797)	in orbit round Sun	internal temp. and press., gas components of interplanetary matter, corpuscular radiation of Sun, magnetic fields of Earth and Moon, meteoric particles in space, cosmic rays	19.997 19.995 19.993 183.6	in orbit round Sun on 450-day cycle; sodium flare released and photographed from ground; probe passed within "two lunar diameters" (about 4,300 miles) of Moon; radio contact held for 62 hr; perihelion 90.9m miles, Jan 14, 1959; aphelion (est.) 122.5m miles, Sept. 1959
Pioneer 4 (U.S.A.) space probe	Juno 2	Mar. 3, 1959	indefinite	conical	13.4	in orbit round Sun	measurement of radiation in space, test photoelectric sensor near Moon	960.05	passed within 37,300 miles of Moon, not close enough (20,000 miles) to trigger photoelectric sensor nor sample Moon's radiation. Tracked for 82 hr to 407,000 miles; perihelion 91.7m miles, Mar. 17, 1959; aphelion (est.) 106.1m miles, Oct. 1, 1959; injection velocity of 24,790 m.p.h. was 188 m.p.h. below planned velocity

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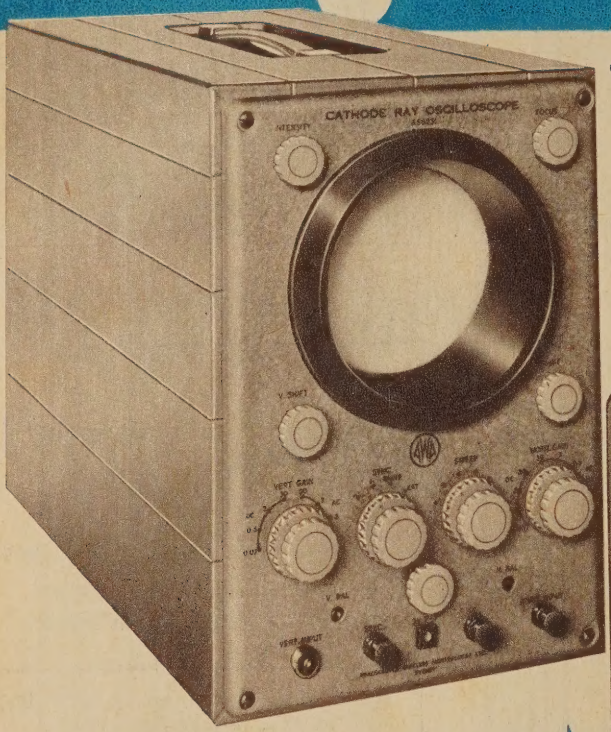
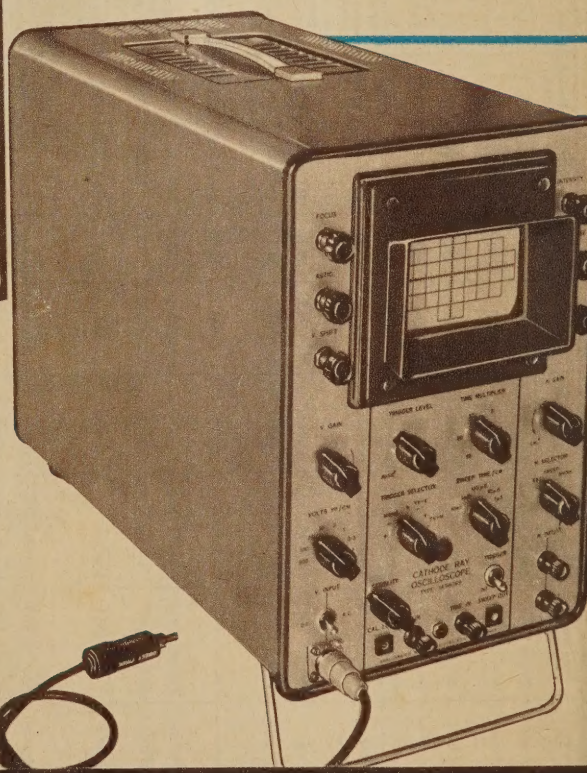


CATHODE RAY OSCILLOSCOPE A56031

FEATURES :

- ★ Identical horizontal and vertical amplifiers, frequency response zero to 1 Mc s.
- ★ Good sensitivity, vertical 12 mV p-p c-m, horizontal 2 mV p-p c-m.
- ★ Comprehensive synchronising facilities, internally from mains voltage or vertical input or from external source.
- ★ Wide range time base, 3 c s to 30 kc s, with preset speeds at half TV line and field frequencies.



CATHODE RAY OSCILLOSCOPE A56031

FEATURES :

- ★ Wideband vertical amplifier, zero to 6 Mc/s.
- ★ Horizontal amplifiers time calibrated, 1 uS/cm to 0-5 sec/cm.
- ★ Vertical amplifiers voltage calibrated 0.1 -300V p-p/cm.
- ★ Automatic synchronising.
- ★ Built in TV sync. separator.
- ★ Provision for oscilloscope camera.
- ★ May be intensity modulated.
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THE DIRECTOR OF JODRELL BANK

Framed against a background of the 250ft. radio telescope is Professor A. C. B. Lovell, Professor of Astronomy at Manchester University and Director of the Experimental Station and Radio Telescope at Jodrell Bank.

☆

Prof. Lovell decided to use the Jodrell Bank facilities to track the sputnik, by connecting radar transmitters (previously used to obtain moon echoes) to the 250ft dish of the radio telescope.

Radar contact with the satellite's carrier rocket was successfully obtained and orbital data was sent to Moscow following a Soviet request.

This was followed by similar radar tracking of Sputnik II and the carrier rocket of Sputnik III, and by a more ambitious joint Anglo-American effort concerned with receiving signals from the subsequent U.S. lunar and space probes.

This latter work provides the explanation for the electronics trailer labelled SPACE TECHNOLOGY LABORATORIES, which is now parked at the side of the main radio-telescope control block.

The team of U.S. electronics engineers at Jodrell Bank, led by William Young of S.T.L., utilise American receiving and recording equipment in connection with aerials mounted on the 250ft radio-telescope dish to receive signals from the battery-powered transmitters aboard various U.S.A.F. and N.A.S.A. space probes.

SATELLITE SIGNALS

The primary purpose is to record the telemetry signals transmitted by the probe during the period it is above the horizon and the secondary purpose is to keep track of the probe's position in space by means of the steady beacon signal.

Advantages of employing the Jodrell Bank radio telescope are that its great sensitivity enables weak signals to be received up to great distances; and its beamwidth is small enough for a probe's position to be determined with considerable accuracy.

The position of the probe as determined by the telescope is transmitted continuously by teletype direct to the U.S.A. from the unit at Jodrell Bank, and the magnetic tapes and paper charts carrying the telemetry data are airmailed after a modest amount of data reduction on the spot.

This information is received at the S.T.L. computing centre in Los Angeles, where it is further processed and, together with data from other tracking stations, is conveyed to the U.S.A.F. and N.A.S.A.

Pioneer 1, which reached 70,700 miles, and Pioneer 4, which passed the moon to become an artificial planet of the sun, were both successfully tracked, and telemetered data was obtained. Pioneer 4 was tracked to a distance of about 400,000 miles before its batteries became exhausted.

Prior to a space-probe launch, details of the expected trajectory are supplied to Jodrell Bank from the U.S.A.

In the case of a lunar-probe firing from Cape Canaveral the probe would appear over the Jodrell horizon to the south-west and be picked up by the radio telescope about 10 minutes after launching, after which it would take a further 20 minutes to attain an elevation of some 30 degrees to the south.

The exact position of the probe is checked at 10-minute intervals by moving the telescope off track and scanning back through the maximum-intensity position, in both azimuth and elevation.

The co-ordinates at which the maximum signal is received indicate the angular position of the probe with an accuracy which depends on the beamwidth and hence on the frequency.

At a frequency of 1,000 Mc/s the beamwidth is 20 minutes of arc and the probe can be located to within a few minutes of arc.

Satellites and probes, although perhaps the most publicised interest of the Jodrell Bank establishment, are not its main concern.

As a university department possessing the world's most powerful radio-astronomical tool of its type, Prof. Lovell's group is basically concerned with exploring and mapping the vast spaces of the universe. There are several areas, however, in which data from satellites and probes are of direct use in these basic studies.

IONOSPHERIC RESEARCH

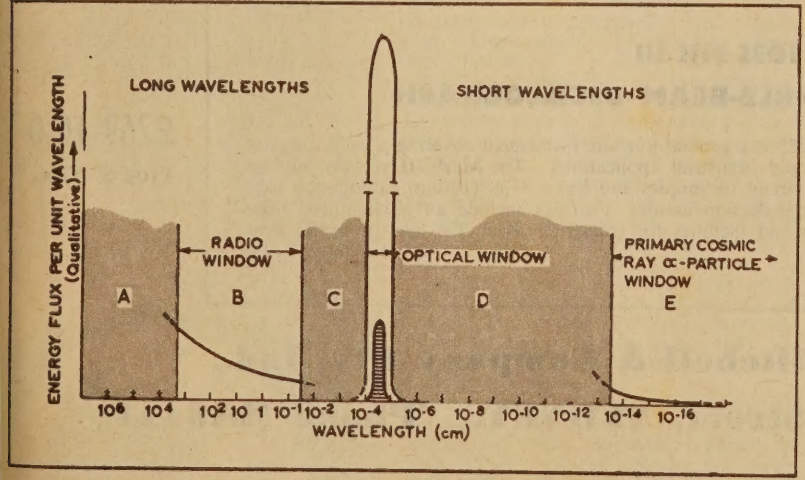
The resident group concerned with satellites at Jodrell Bank, led by Dr John Thomson, works closely together with Dr John Evans' team responsible for moon and planetary echo research.

The reception of signals from Vanguard I (whose solar-powered transmitters are expected to continue to operate indefinitely) is providing detailed information on the nature of the ionosphere, including a study of the way in which the polarisation plane of these signals rotates in passing through the ionosphere.

This phenomenon was first observed in radio echoes from the moon.

In addition, much of the telemetered information from space probes (the prime concern of the U.S. team at Jodrell) is relevant to the station's basic research, in fields such as micrometeorite experiments, radiation and magnetic fields and cosmic ray intensity.

(Continued on Page 105)



"Windows" in the radiation spectrum: A, radiation cut off by atmosphere; B, some absorption, but atmosphere essentially transparent in this region (radar, UHF, VHF); C, radiation cut off by atmosphere gases; D, radiation cut off by atmosphere (cosmic-ray particles cut off by atmosphere and magnetic field); E, gamma rays and X-rays. The shaded area in the optical window represents eye sensitivity.

Two names famous for Oscilloscopes

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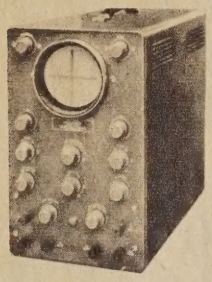
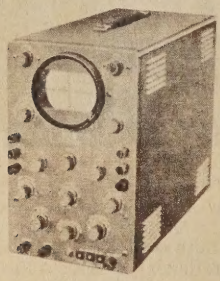


MODEL 1045K

SINGLE-BEAM OSCILLOSCOPE KIT

This single-beam oscilloscope kit can be assembled to provide a useful instrument incorporating a 4 in. (10 cm) cathode-ray tube, two printed-circuit boards and nine miniature valves. Features include X and Y amplifiers of high gain and broad frequency response, a wide range of time-base speeds, fly-back black-out and a calibrating voltage.
(Leaflet CIL. 17)

£74-17-6
Plus S. Tax.

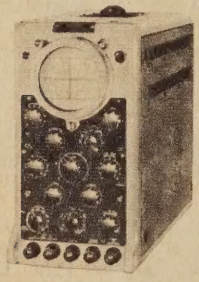


MODEL 1071K

DOUBLE-BEAM OSCILLOSCOPE KIT

When assembled, Model 1071K is a high-grade double-beam oscilloscope incorporating a 4 in. (10 cm) cathode-ray tube, five printed-wiring boards and ten miniature valves. Features include a wide range of time-base speeds, fly-back black-out and an X amplifier for internal or external voltages. The two Y amplifiers (d.c. to 3 Mc/s) are identical.
(Leaflet CIL. 17)

£117-10-0
Plus S. Tax.

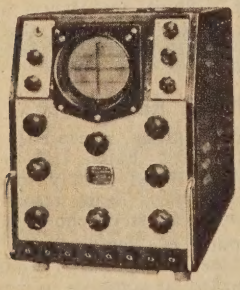


MODEL 1058

SINGLE-BEAM OSCILLOGRAPH

This instrument is fitted with a 4 in. (10 cm) tube with p.d.a. It has a direct-coupled Y amplifier with a sensitivity of 0.25 V/cm and a bandwidth d.c. to 6 Mc/s (50% down). Repetitive or triggered time-base is available. Time-base trigger can be obtained from frame or line sync pulses in a 1V double amplitude pulse (positive) television signal.
(Leaflet CIL. 25)

£175-10-0
Plus S. Tax.



MODEL 1035 MK III

DOUBLE-BEAM OSCILLOGRAPH

Model 1035 is a general-purpose instrument covering a wide range of research and industrial applications. The Mark III version employs modern circuit techniques and has a 4 in. (10 cm) cathode-ray tube with post-deflection anode. Features include an X amplifier, trace bright-up and facilities for triggering from TV line or frame sync pulses.
(Leaflet CIL. 19)

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VLF BEYOND THE IONOSPHERE?

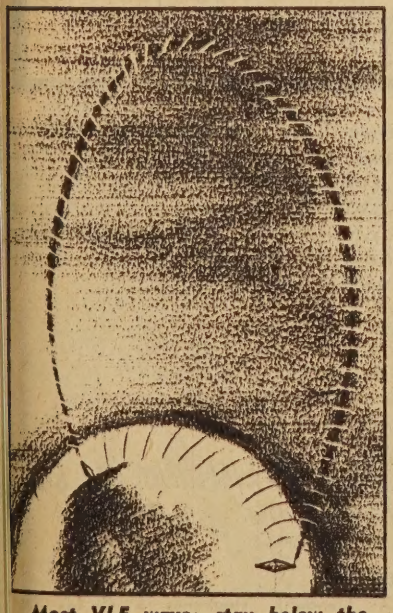
The Exporer VI paddlewheel satellite launched last August may explain a radio communications mystery. Why is it that radio signals of very low frequency (VLF) are sometimes received at a distance from the transmitter, then seconds later are received again? It would seem that the signals take two different paths to the same place, one path considerably longer than the other.

ONE explanation for this behaviour has been suggested by Dr Robert A. Helliwell, of Stanford University. He postulates that while most VLF waves are reflected back to earth by the ionosphere, some of the signals manage to penetrate this barrier and head out into space.

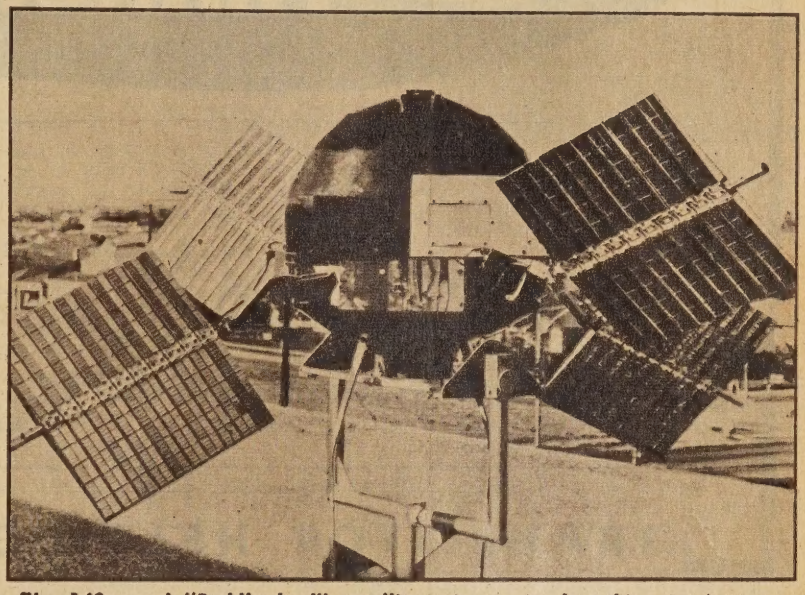
He then suggests that a series of arcs or ducts of ionised matter arch outward high above the ionosphere—but still along the earth's magnetic field—and then return to the earth's surface again.

Such "ducts" would make excellent conductors of the escaped VLF signals, bringing the signals down to earth again many thousands of miles from the transmitter.

Louis H. Rorden adjusts a duplicate of the VLF receiver which was placed in the Explorer VI.



Most VLF waves stay below the ionosphere, but a number may go above it to follow paths that are related to the earth's magnetic field.



The 142-pound "Paddlewheel" satellite prior to its launching in August last. The vanes which give the satellite its name convert solar energy to electrical power.

Because these signals took the "high road," they would arrive some time after those coming more directly on the "low road" below the ionosphere.

If these ducts exist, and if their dimensions and paths can be determined, then they might be deliberately utilised to study radio propagation and ionisation characteristics in regions above the ionosphere.

Under sponsorship of the National Aeronautics and Space Administration, Helliwell's theory is being checked out with a specially developed radio receiver carried in the paddlewheel satellite.

The receiver, designed and constructed by SRI's Louis H. Rorden and Robert N. Beatie of Develco, Inc., is extremely sensitive and is the first VLF receiver ever placed beyond the ionosphere.

A Navy transmitter at Annapolis sends out VLF signals at 15.5 kilocycles. If any do go beyond the ionosphere and follow the conducting pathways, they will be received in the satellite as it crosses a given ionised path.

Telemetering equipment will then relay the signals to the ground. As the satellite crosses the ducts at different points on each of its journeys around the earth, it should be possible to determine a great deal concerning the location, size, and shape of the ducts.

Rorden and Beatie also designed special ground receivers which are now located throughout the world to receive, as a reference, the signal from Annapolis by usual paths—i.e., reflected back from the ionosphere.

These are coordinated with signals from the satellite, and the dual data are processed electronically. After evaluation, the information is expected to give clear evidence of the existence of the postulated ducts.

The experiment is providing other information about ionisation patterns above the earth. For example, the structure of electronic dispersion in the ionosphere had only been estimated before.

At the time the satellite was launched, the receiver inside was receiving the radio signals full strength and relaying them.

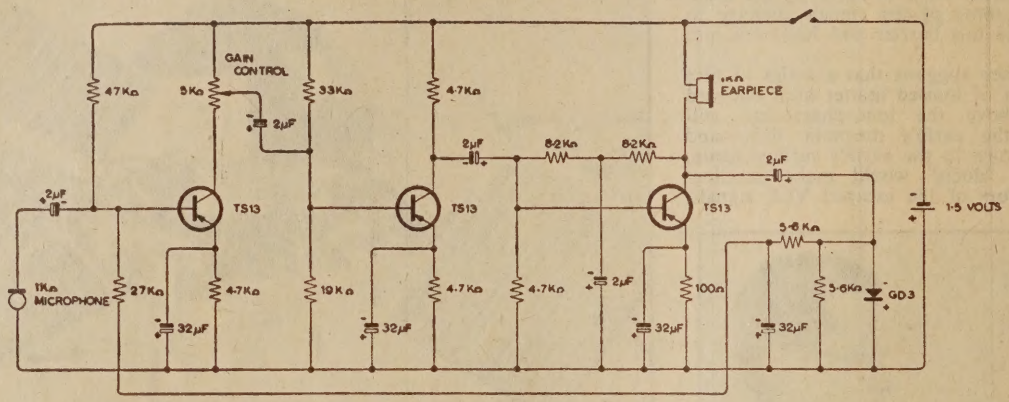
However, as the rocket rose higher into the sky, the signals suddenly dropped off. This happened because the receiver had reached the ionosphere, which most of the ground signals could not penetrate.

The detailed structure of the fall-off of the signal was observed as the rocket continued upward, giving an indication of the make-up of the ionosphere through which it passed.

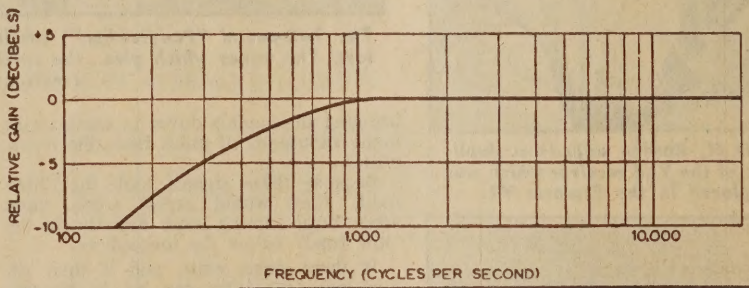
Not only will the receiver demonstrate how much low-frequency radio "noise" gets through the ionosphere from the earth below, but it should register any VLF waves that may originate in outer space.

Therefore, even if the space duct theory goes unproved, this experiment will provide researchers with much new information regarding radio waves and ionisation patterns in space.

STC SETS THE STANDARD FOR TRANSISTORS



TRANSISTOR HEARING AID UNIT



The circuit diagram above shows a transistor hearing aid unit capable of very good performance, although of simple design.

It is intended for use with an earpiece and microphone of the magnetic type, both of which are readily available. The absence of iron-cored transformers enables the unit to be of very small physical size.

The voltage gain is approximately 45 dB. with a supply voltage of 1.5 volts, which is generally adequate; it can be increased to approximately 54 dB. by using a supply of 3 volts. The current drain at 1.5 volts is 3.5 milliamperes. If even greater gain is required, an additional transistor can be added.

The frequency response of the amplifier itself is shown in the accompanying curve; the response of the entire unit will depend also upon the characteristics of the microphone and earpiece.

The audio frequency output voltage is rectified by means of a germanium diode, filtered and applied to the base of the first transistor to operate as an automatic gain control system.

Australian-made S.T.C. transistors have proved their value in a vast number of applications. As the use of transistors grows, S.T.C., backed by world-wide research, is adding more new types to its already wide range. First to make transistors in Australia, S.T.C. keeps its lead in quality, reliability and performance.

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M182D

OXYGEN FOR SPACE TRAVELLERS

Fifty-nine white laboratory rats, apparently hale and hearty after a high-altitude flight which never left the ground, are helping to discover whether man can live comfortably in space.

THE rats—59 of them consume about the same amount of oxygen as a human, and give off approximately the same amount of carbon dioxide and moisture in their breaths and heat from their bodies—recently were enclosed in a Boeing high-altitude chamber.

This 100-cubic-foot chamber resembles a deep-sea diving bell. During tests, "altitude" inside the chamber was kept at 15,000 feet.

In actual flight this pressure would be maintained even though the vehicle might be orbiting around the earth hundreds of miles in space.

FURTHER TESTS

The 15,000-foot "altitude" was chosen for test purposes; it is not necessarily the best interior pressure for an actual vehicle.

The earth-bound flight was used to test a new cabin-conditioning system developed by Boeing engineers for crews of hypersonic or orbital vehicles on trips of comparatively short duration.

If further tests prove successful, the Boeing cabin-conditioning system may make it possible for crews to be comfortable in space without pressure suits and other special equipment.

The Boeing system relies on a mixture of liquid oxygen and liquid nitrogen carried aboard the vehicle in a single container. Most systems now in existence carry oxygen and nitrogen separately, and feed the oxygen directly to crew members, while the nitrogen is piped into the cabin through another line.

The normal atmosphere of the earth contains approximately 79 per cent nitrogen, 20 per cent oxygen and 1 per cent other gases.

Air is only half as dense at 15,000 feet as at sea level; consequently there is only half as much oxygen in a free atmosphere at 15,000 feet, an amount inadequate for most humans.

Oxygen is the essential element required by man. Increasing the percentage of oxygen in a 15,000-foot atmosphere from 20 per cent to 40 per cent brings the net amount of oxygen up to the same amount that is found at sea level.

The percentage of nitrogen apparently may be reduced to 60 per cent or less without effect on rats or humans, although further tests must be made.

The atmosphere in the Boeing system tested was composed of 40 per cent oxygen and 60 per cent nitrogen. The one per cent of miscellaneous gases were eliminated.

ADVANTAGES

The amount of oxygen taken in at each breath by each rat was approximately equal to the amount breathed at sea level.

The single container for the oxygen-nitrogen mixture used in the Boeing system is lighter than the two containers used in other systems. The Boeing system also eliminates the use of pure oxygen which is a possible fire hazard.

When the liquid mixture of oxygen and nitrogen in the Boeing system leaves its container, the temperature of the liquid is about 320 degrees below zero.

First the liquid circulates through and cools electronic equipment in the vehicle. In this process the liquid is warmed to nearly room temperature.

The warm liquid is metered into the crew compartment and becomes a vapour as it is released. This vapour cools the cabin and provides a breathable atmosphere.

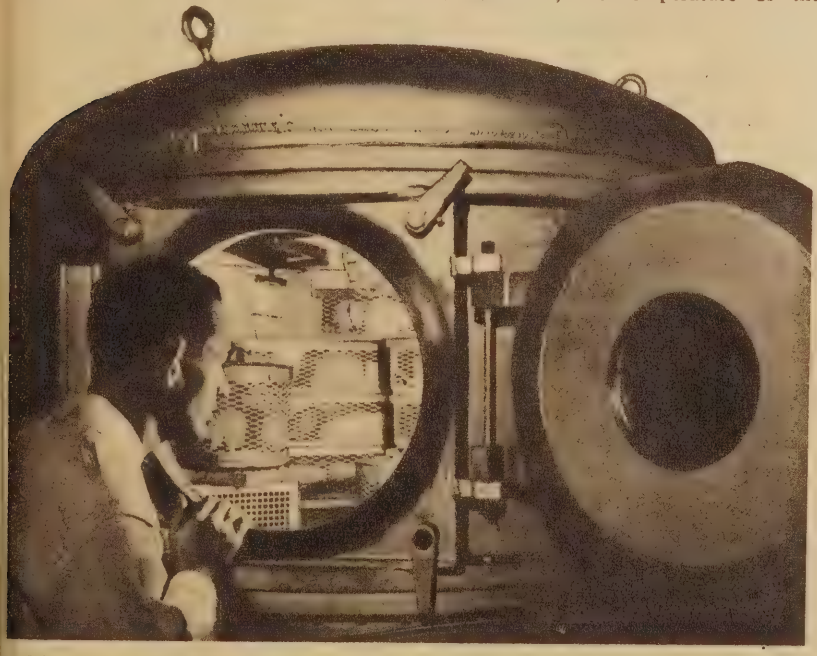
Dubbed a "wash-through" system, it depends on a sufficient number of air changes per hour to purge the compartment of carbon dioxide given off by the crew breathing. As pressure levels inside the chamber rise, a pressure-controlled valve opens and exhausts the gases outside the vehicle.

An alternative method, employing a temperature-control valve which lets in cool nitrogen-oxygen vapour when the chamber heats up, and shuts off the vapour when the temperature drops, may be used.

The laboratory animals survived the tests with no apparent ill effects, and remained calm and apparently comfortable throughout the test run.

The single-container system probably would be most efficient for flights of a few days or less. For longer flights another system employing purification and re-use of the gases would be more efficient.

These are the white rats who "double" for man in the oxygen experiments. Approximately 59 breathe as much air as one man.



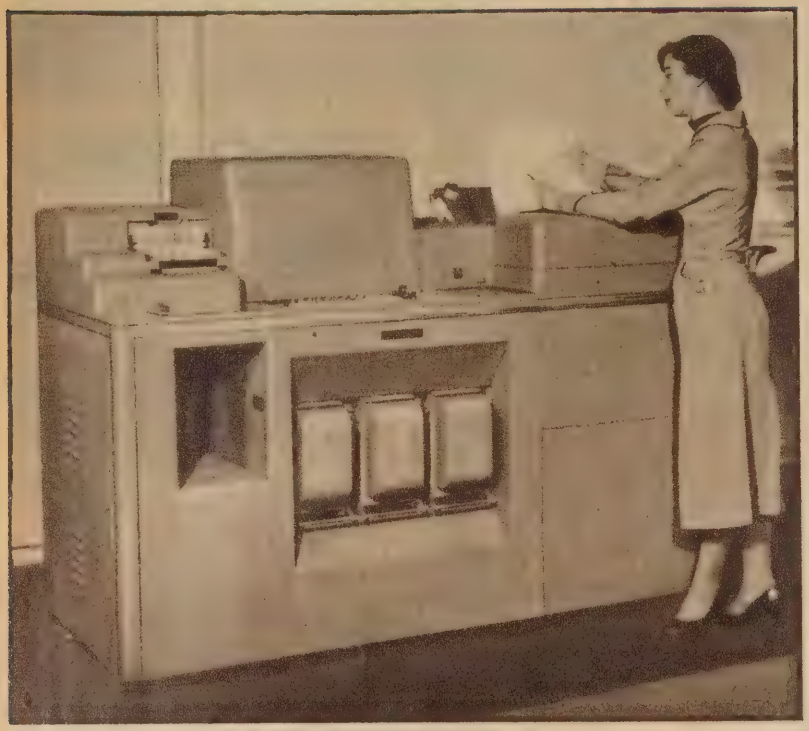
This diving bell-like chamber is used to house cages of white rats while engineers experiment with various systems intended to supply oxygen to future space travellers. By simulating various "altitudes" the most efficient use of the oxygen can be investigated.

CAN WE LEARN TO HIBERNATE?

ON the other side of the Atlantic another approach to the oxygen-in-space problem has been put forward.

James Danielli, Professor of Zoology at King's College, London, speaking in the series "Man's Knowledge of Man" in the B.B.C. said:

"In space travel one of the big problems involved is to supply human beings with sufficient oxygen. One way of solving this would be to find out how to make human beings hibernate. When an animal hibernates its body temperature falls and its requirement of oxygen falls enormously. Many animals hibernate spontaneously, but no doubt we can find out how to induce hibernation in man, and so make space travel easier to achieve."



This "custom built" Rolling Total Tabulator can take over an enormous amount of tedious clerical work, such as the production of invoices, statements, payrolls and statistical analysis.

COMMERCE—AND A PACK OF CARDS

LAST month we saw how the punched card was developed. Examples were given showing how the card is punched and how the punch holes represent data taken from documents.

By CALVIN WALTERS—Part Two

THIS article deals more particularly with the handling and classification of cards after punching.

The scope of a punched card, in containing a wide variety of data in a permanent form, is almost limitless.

In fact, it has been said that the limitations of the system are set mainly by the ability of the human brain to find work for it to do.

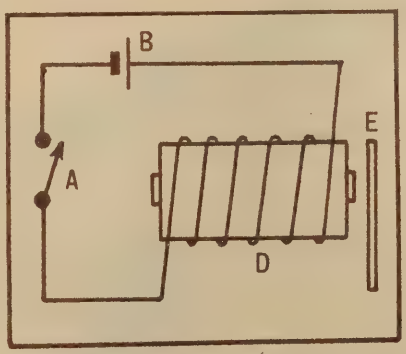
The punched card is of no use, however, without means of translating it and our purpose here is to show the method which is used for extracting the data contained on the card.

SIMPLE CIRCUIT

Consider the simple switching circuit given herewith. Switch A is connected through a source of electric current B to the electromagnetic relay D, which is furnished with an armature E.

When the switch A is closed, current flows through the coil of the relay, magnetising the iron core. This, in turn, attracts the armature E, which remains closed until released by switching off the current flowing through the relay coil.

It follows that, by connecting suitable mechanism, the armature can be made to carry out a variety of functions, such as operating a type bar, opening and closing a shutter, operating another switch, turning a wheel and so on.



This diagram illustrates the action of an electrical solenoid system.

If we pass a card punched with holes between the contacts of the switch, current will flow every time the contacts fall into a hole and the relay will operate. When there is no hole the card acts as an insulator and keeps the contacts open. Current will not flow, the core remains unmagnetised and the armature remains open.

Thus, whatever is connected to the armature will function every time a hole in the card registers with the switch contacts.

If we have a row of 80 switch-relay circuits, one for each column in the card, we can cause up to 80 functions to be performed when the card is passed between the contacts.

As each relay can operate another, and so on, the number of functions which can be carried out is virtually without limit.

SENSING MECHANISM

The mechanism which senses the holes in the punched card is similar to the switching system we have been considering. A metal roller carries the card under a series of light brushes providing the other contacts. This is illustrated in an accompanying diagram, where details of an electrical sorting machine are given.

In this respect, we can cast our minds back to the player piano. There is a marked similarity between the way one of these instruments operates and the mechanism which senses the hole in a punched card.

For a player piano, the roll of paper is initially punched with holes representing the musical notation. The roll is passed over a bar, perforated with the 88 notes of the piano. To each hole in the bar is connected a tube which terminates in a small bellows. To one side of the bellows one hammer of the piano is connected.

As the paper roll passes over the holes in the bar, air is drawn through the tube, as each hole in the paper registers with the appropriate hole in the bar.

BELLOWS ACTIVATED

The small bellows is thus alternately opened and closed and, in doing so, operates the hammer, which strikes the strings and produces the required note.

It is not hard to imagine the hammers of the piano being replaced with the bars of a typewriter and we have a mechanical typing machine.

Reverting to our switching arrangement it is simple enough to replace the perforated bar of the piano with a series of 88 switches. The bellows for the hammers can be replaced with relays.

Thus, every time a hole in the paper roll registers with a switch, the appropriate hammer operates and we have an electric piano.

One of the basic needs of the punched card system is to be able to sort the cards into any desired sequence. In fact, this function of sorting can be said to be the

backbone of the system, because it is possible to store cards in any random order.

By means of coding schemes, any hole in any position on the card can be made to represent something. It may be a sales territory, the name of a person, a chemical formula, an article of clothing, an amount of money, a person's marital status, the sex of a person, the colour of his hair, his fingerprint classification and so on.

Assume then that we have thousands of cards stacked at random in containers. The card is punched with coded information giving a customer's account number, the territory in which his business is located, the amount of his purchase, the coded details of some garments he purchased and so on.

TYPICAL EXAMPLE

We want to find out what is the most popular garment in any particular territory.

Territories, let us say, are coded in a card field using columns 5 and 6. Thus the code for territories would contain up to two numbers.

Types of garments are coded, say, in columns 7, 8 and 9. Thus the code would contain up to three numbers.

Now if all these details were written on a card by hand and filed away in the normal fashion, it would involve a vast amount of clerical labour to sort the required details from the mass of cards.

With the punched card sorting machine, sorting is done from a stack of jumbled cards at a speed of up to 60,000 cards an hour, depending on the type of machine.

The sorting machine sorts column by column. For instance, in our example the territory may be 42. Thus 4 would be punched in column 5 and 2 in column 6.

The machine would sort all cards with the particular punch hole in column 5. They would then be passed through the machine to sort cards with the hole in column 6.

The same would be done with the coded numbers for the type of garment. Considering the speed with which sorting is carried out, the process does not take long.

The sorting machine is a very fascinating thing to watch. It consists of a series of 13 boxes. One box for each of the 12 punching positions of the card and an extra box for cards which have no holes punched at all.

As the cards are sorted by the machine, they fall into their respective boxes at incredible speed.

The essential mechanism of the sorting machine is shown in the diagram.

"A" is the sensing brush mentioned earlier, which forms one half of the switch. B is the metal roller forming the other half of the switch. C is the card passing between the brush and roller. D is the electromagnetic relay with its armature E.

Above the armature E will be seen 12 chute blades, numbered left to right, R, 11, 10, 0, 1, 2, 3, 4, 5, 6, 7, 8 and bent downward at the end and supported by the armature. Each of these blades terminates in one of the 12 boxes. The thirteenth box has no chute blade for a reason which will soon be clear.

Batches of cards in random order are placed in a feed hopper at the side of the machine. They are placed face down with the 9 edge of the columns leading.

Cards are fed from the bottom of the stack. (This does not mean that the machine can be used by a dishonest poker player for dealing his cards.)

Selection of the column which it is desired to sort is done by means of threaded rod, which is provided with a pointer sliding along a scale. The scale is numbered from 1 to 80, corresponding to the columns on the card. The threaded arm also carries the sensing brush.

A wheel on the side of the sorter enables this pointer and brush to be placed into the desired position.

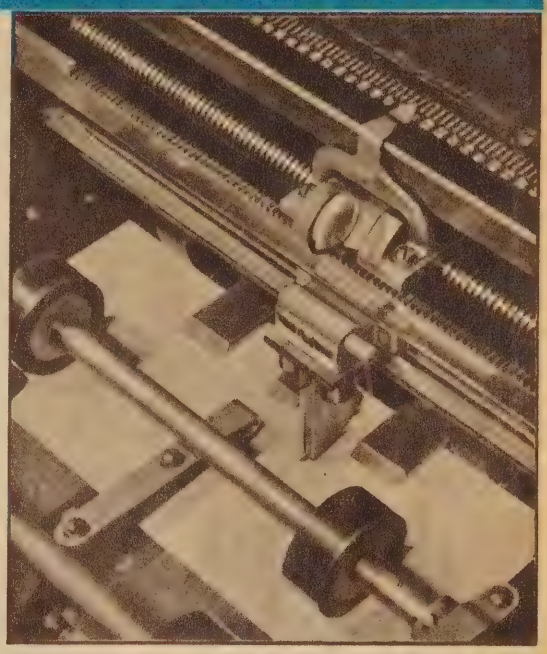
The assembly can also be lifted and moved quickly from one end of the scale to another like a gramophone pick-up.

SORTING SEQUENCE

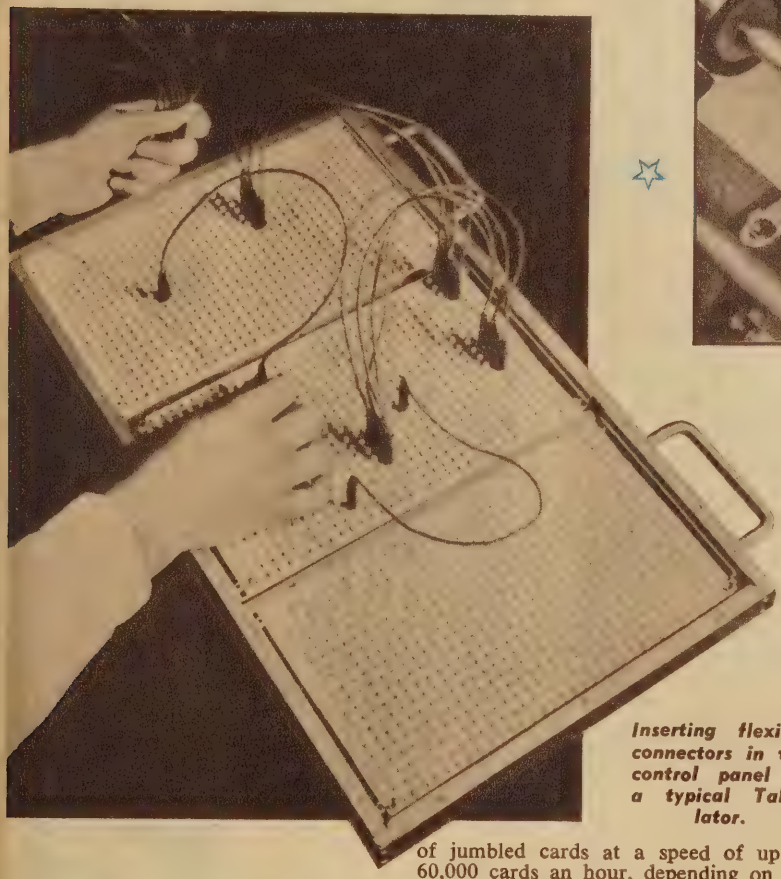
Cards are sorted column by column and hole by hole. Let us assume that we want to sort all cards with a hole in the column 4. There can be up to 12 holes in any column—from 0 to 9 plus positions 10 and 11. Or there can be no holes. The pockets into which the cards fall are arranged in a row in correct order.

When the machine is set in motion

CONTACT BRUSH INDEX SYSTEM



A sorter sensing brush which actuates an external circuit when it completes an electrical contact through a punched hole. Note the brush indexing mechanism, which allows it to be set quickly and accurately to any desired position.



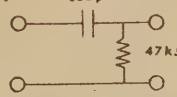
Inserting flexible connectors in the control panel of a typical Tabulator.

acos

Crystal stereophonic cartridge

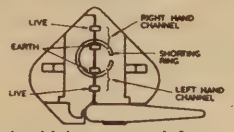
The "ACOStereo" 73 series is a universal cartridge designed to play stereophonic and microphonic discs, including 78 r.p.m. coarse-groove records. Three brackets are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC.110 and RC.120 changers, and the "c" bracket is intended for American arms of the VM type.

The output from the "ACOStereo" 73 is flat when fed into a 2 Megohm impedance. If record compensation is available in the amplifier it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:—



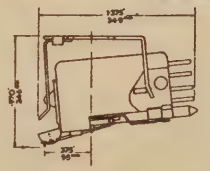
The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience and is recorded on the left-hand groove wall when the record is viewed as:—

The "ACOStereo" cartridge connections as seen from the rear:—



The shorting ring should be removed for use with amplifiers requiring separate leads.

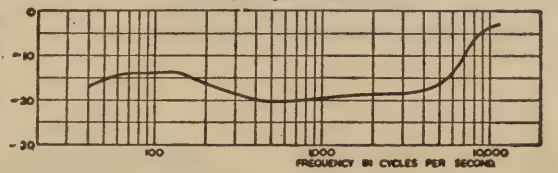
"How Stereo Works" gladly posted on request.



Performance	GP73-2	GP73-5
Output at 1 Kc/s	225mV/cm/sec. R.M.S.	665mV/cm/sec. R.M.S.
Frequency Response:	Flat 40 c/s-12 Kc/s	Flat 40 c/s-6 Kc/s (Approx. 10dB down at 10 Kc/2)
Separation:	15dB at 1 Kc/s	10dB at 1 Kc/s
Stylus tip radii:	.0007" Stereo L.P. .0025" Standard	.0007" Stereo L.P. .0025" Standard
Recommended Load:	2 Megohms	2 Megohms
Compliance:	2.5 x 10-6 cm/dyne	1 x 10-6 cm/dyne
Recommended Tracking Weight:	4/6 Grammes	6/8 Grammes

73-2A AND 73-5A . . .
Are the same physically but differ electrically.
All 73 series cartridges are available with two sapphire, and sapphire and diamond styli. Price: 73 series—cartridge incl. two-sapphire styli—£5/15/-; with sapphire and diamond styli—£11/18/6. Available ex stock.

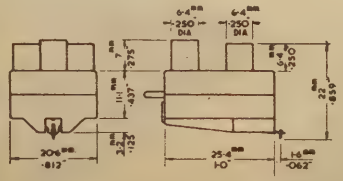
Frequency response on PS.131.



Separation between Channels on PS.131.

Performance: GP71-3

Output ..... 200 m.v. @ 1.5 cm/sec. Frequency Response ..... 40-12,000 c/s.
Separation between channels at 1 Kc/s ..... better than 15dB.
Radius of Stylus Tip ..... 12.5 microns min.: (0.00048").
..... 15.0 microns max.: (0.00058").
Recommended Load ..... 2 Megohms. Compliance = 1.5 ucm/dyne.
Stiffness = 0.067 x 10-6 dynes/mm.
The cartridge will track at a minimum of 2 Grammes, dependent upon the lateral freedom of the Tone Arm. Pressures in excess of 8 Grammes are not recommended due to excessive record wear.
71-3—for stereophonic and L.P. discs (non-turnover type).
Price £4/9/6 —with sapphire stylus.
Price £10/17/6—with diamond stylus.



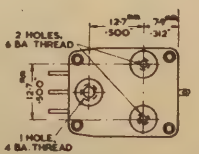


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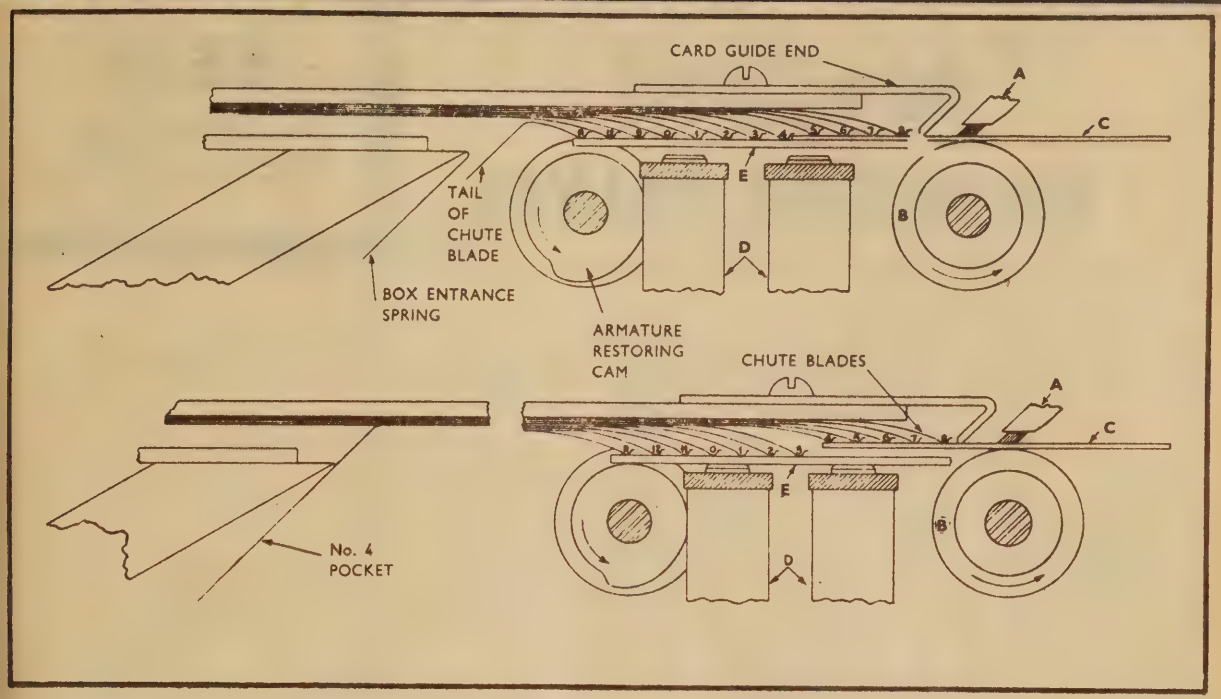
DIAGRAM SHOWS HOW THE CARDS ARE SORTED



In the upper diagram, card C has passed under chute blades 8, 7, 6 and 5. In the lower diagram it has also passed under 4, but operation of the solenoid will cause it to pass between chute blades 3 and 4, into the appropriate box.

the card is carried under the sensing brush.

If there is no hole anywhere in the column, no current will be supplied to the magnets D, so that the armature E will remain up, supporting the chute blades. The card will be carried under the chute blades and fall into the reject pocket.

If there is a hole in Number 9 in the column the brush senses the card before it reaches the first or number 8 chute blade. The armature is attracted and all blades fall with it. The card passes over the top of number 8 blade and falls into the 9 pocket at the far end.

EXTRA POCKET

The above explains why there are 13 pockets (one for the cards with no hole) and why there is no blade numbered 9.

If there is a hole in position 8 in the column the sensing brush makes contact through it just before the edge of the card reaches number 7 blade, and just after it has passed number 8 blade. The magnet will be supplied with current, the armature falls and all blades except number 8 will fall with it.

Number 8 cannot fall because it is held up by the card. The card is carried by rollers between number 7 and 8 blades until it falls into number 8 box at the end of the travel.

A hole in number 7 position will cause the armature to fall just after the edge of the card has passed number 7 blade and before it reaches number 6. The card is carried over number 6 blade to number 7 pocket.

This process is carried out throughout the length of the column so that, at the end of the run, all cards which have a hole punched anywhere in the column at which the brush has been set lie in the boxes of the sorter from 0 to 11. If the stack of cards is taken from any box and held up to the light, it should be possible to see right through the pack of cards through the hole.

Remember that this sorting is done at a fantastic speed of 60,000 cards per hour. It is a fascinating thing to see the cards falling into the respective boxes.

When one of the boxes becomes too full of cards, a simple switching arrangement stops the machine until the box is emptied.

In our example of finding the most popular garment sold in sales territory 42 we saw that the territories were coded in columns 5 and 6. Thus column 5 would be punched in the 4 position and column 6 in the 2 position.

The sorting brush would first be set to sort column 5. All cards are then removed from the boxes and those from box 4 put back through the machine with the brush set at column 6. All cards in box 2 at the end of the sort would be cards relating to territory 42.

ILLUSTRATION

In the illustration of the chute blade device the brush is falling into a hole punched at 4 (bottom section of diagram). The card has travelled under the 8, 7, 6, 5 and 4 blades before the sensing brush makes contact and energises the magnet. Chute blades R, 11, 10, 0, 1, 2 and 3 have dropped with the armature, leaving blades 4 to 8 supported by the card which passes over number 3 blade to the number 4 pocket.

There is a selective device on the sorting machine which allows any hole in a particular column to be selected for sorting.

This device is in the form of a commutator with sliding contacts at the edge.

By setting the contact for a particular hole in a column, the electric current is cut out from the sensing brush for all holes except the one selected. All cards, therefore, without the selected hole, pass under the armature into the reject box without their sequence being disturbed, whilst the cards with the selected hole will fall into the appropriate box.

This "commutator" switch enhances the value of the sorter very considerably. Not only will it select a particular hole, it will select a group of holes, say hole 8, 4 and 2 in a particular column, and so on.

There is also a device which will select any card or cards punched with a predetermined number from a stack of cards, without disturbing their sequence.

OTHER FUNCTIONS

Then there is a device to extract balance cards of unmoved accounts from a stack of filed cards. Another device counts the number of cards passing through the sorter.

Having sorted the cards in the desired sequence it is necessary then to extract from the cards the punched information, process it and present the results, in printed words and figures, in the required form. This is done on the tabulating machine.

This machine may be compared with the assembly shop of a factory. It is that part of the installation from which finished products are delivered, these being in this case invoices, payrolls, costs, ledger sheets, and so on. It will also present innumerable kinds of statistical information and figure analysis.

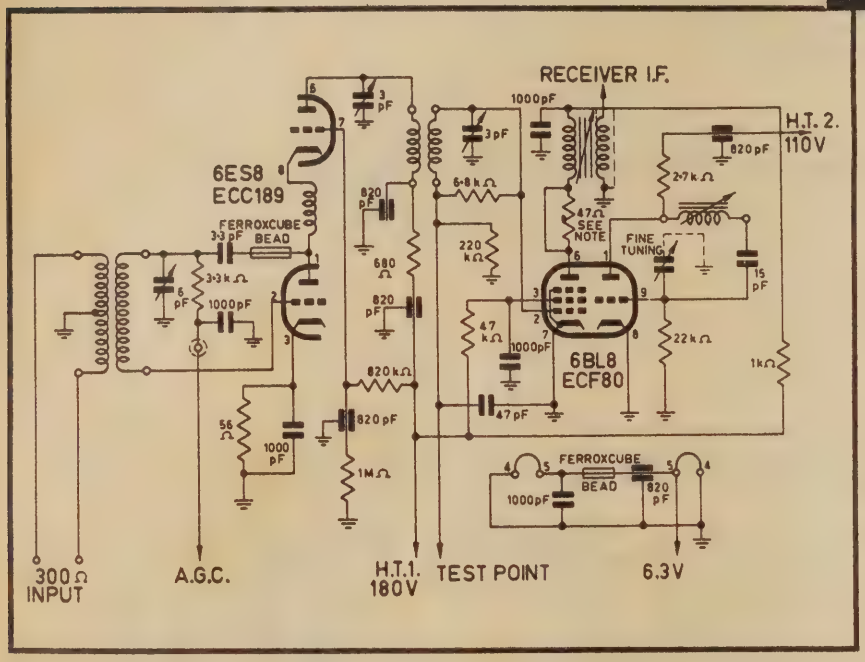
The tabulator consists essentially of a

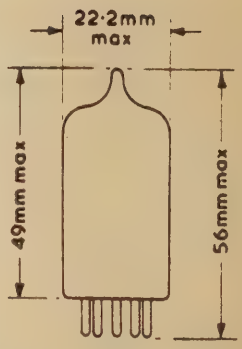
(Continued on Page 110)

Mullard
TELEVISION VALVES

6ES8

Variable-mu Frame Grid Double Triode

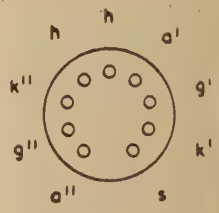




6ES8 CHARACTERISTICS

Heater Ratings	*6.3V at 365mA*
Va (each section)	*90V*
Ia (each section)	*15mA*
u (each section)	*12.5mA/V*
Vg (each section)	*—1.2V*
**Vg (each section)*	*—9.0V*

** For 100:1 reduction in cascode slope.*



B9A Base

The Mullard 6ES8 is a variable mu frame grid double triode primarily intended for use as a cascode amplifier at frequencies up to 220 Mc/s in television receivers. This 6ES8 offers a new concept in television valve construction and leads to the design of television receiver tuners of increased gain and superior noise figure.

MT95

ISSUED BY THE TECHNICAL SERVICE DEPARTMENT

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Technical Review

AUTOMATIC LOCATION OF DOCUMENTS ON MICROFILM

The U.S. National Bureau of Standards has developed an improved model of an automatic document-retrieval device for the Patent Office and the Navy Bureau of Ships. The machine rapidly retrieves information from massive files of correspondence, drawings, patents, or similar printed matter which have been recorded on 35-mm microfilm.

ASSOCIATED with each document image is a binary dot code which identifies the content of the document. The machine examines these codes rapidly—about 2,400 pages/minute—and when a desired document is found, photographs it on a strip of recopy film.

Development work on this rapid selector was carried out by T. C. Bagg of the data processing systems laboratory.

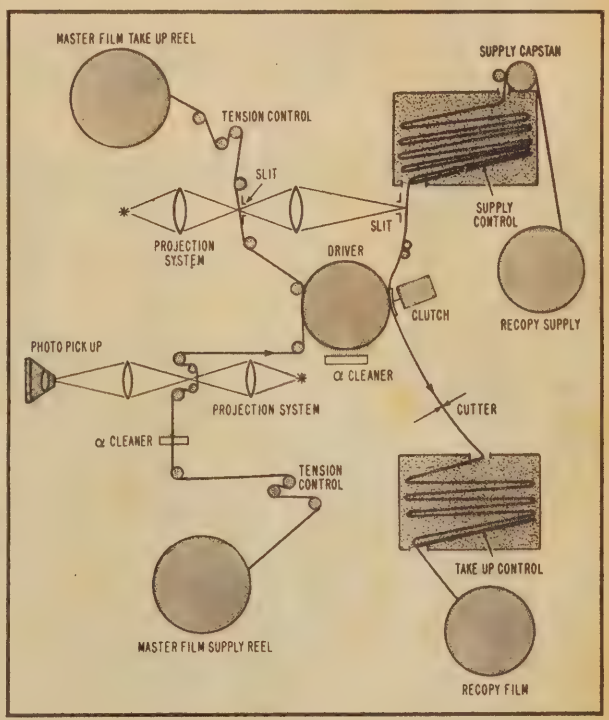
The rapid selector is an outgrowth of an idea originally proposed by Dr Vannevar Bush more than 20 years ago.

More recently, Yale University undertook the redesign of the machine to meet its own specialised requirements in document search.

Subsequently, the Patent Office and the Bureau of Ships asked the National Bureau of Standards to study the machine to see how it could be further changed to meet their particular needs.

For this program, the bureau obtained a portion of the Yale equipment, modified the optical and mechanical systems and redesigned the electronic circuitry using modern computing machine practice.

☆



This diagram illustrates the operation of the film transport system used for the rapid selector developed by the N.B.S.

☆

CODE MARKINGS

The machine identifies the required document by examining a binary dot code associated with each document.

A single code frame is about ¼in long and as wide as the film, and contains six rows of 46 bits each; 40 bits are for document information and six bits are for machine control.

The mechanism that reads these rows of bits has sufficient tolerance to allow for normal dimensional changes in the film and slight skew in the rows.

As the film passes through the machine, its image is projected on a bank of photocells which scan the code.

When a desired item is found, a high-speed clutch mechanism is activated. This clutch presses the recopy film to a drive drum, accelerating it to the same speed as the information or master film.

By means of slit photography the desired item on the master film is registered on the recopy film. After the desired item passes the camera slit, the clutch is disengaged and the recopy film stops.

As many consecutive items as desired can be copied without slowing or stopping the master film. The output of the machine is a recopy film on which are registered all the documents of interest.

TEST FILM

To test the operation of the rapid selector, a test film was prepared. It contains the contents of the N.B.S. Technical News Bulletin for about a 10-year period to show the wide variety of subject material that can be located with the selector.

In all, more than 250 individual categories, simply or in combinations, were used in the index to describe the 900 articles. Successful searches on this test film have shown the practicability of the system.

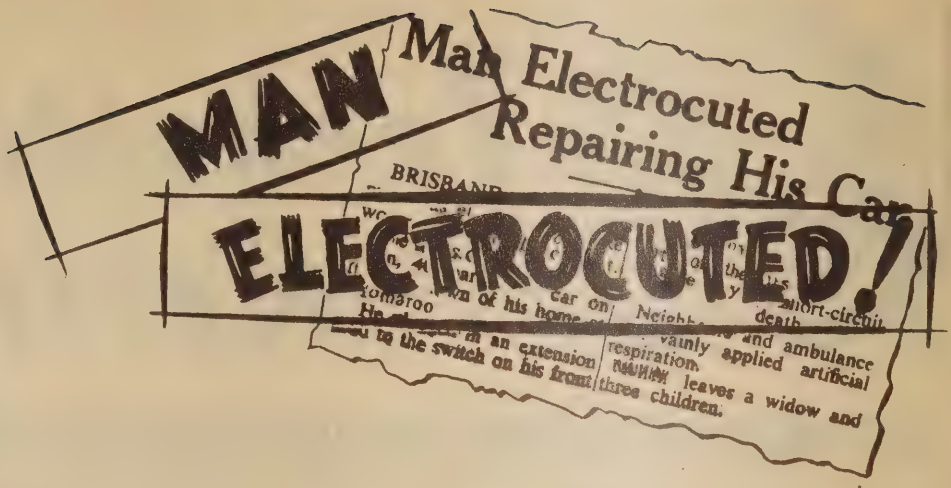
The present selector is limited to using only one word per document. This word can represent many combinations of concepts.

An improved electromechanical film transport combined with a multiword selector, now under construction, will perform much more rapid and sophisticated searches than the present machine.

In the improved selector, signals caused by the recognition of the machine words can be combined using computer logic to give the printout command. A six machine-word code has been devised with which the Bureau of Ships is encoding a series of letters to be used in an encoding study.

With this code system they will be able to find any letter or letters, written between certain dates, from a particular supplier about a specific type of equipment.

(For further technical information, see Status report on the rapid selector, by P. F. Ordung and T. C. Bagg, Proceedings of the A.I.E.E. Summer Meeting, Mintreat, Quebec, Canada, June 24-28, 1957 (CP57-862).)



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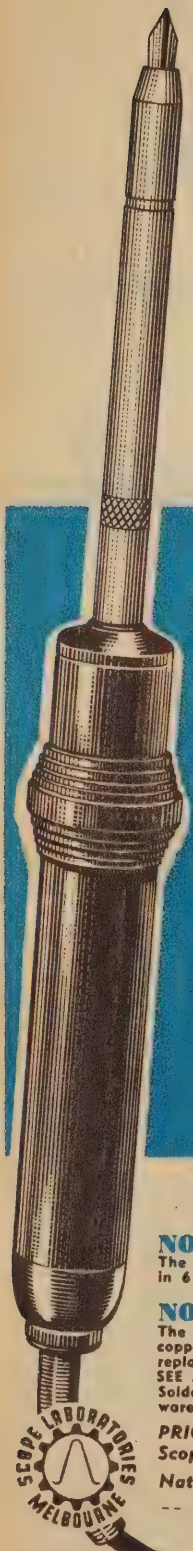
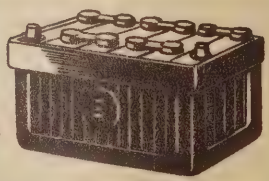
SCOPE SOLDERING IRON



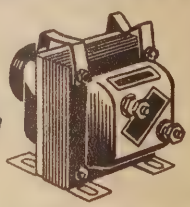
The Scope Soldering Iron operates directly from your car battery or for bench work from extremely low voltage derived from the National Scope Transformer. This transformer has an output voltage of 3.3v and is specially designed for maximum protection on the mains input side.

The National Scope Transformer is fully approved under prescribed articles of the Electricity Authority. Approval No. N/156.

OPERATES FROM



CAR BATTERY or



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The Scope Iron heats instantly attaining full operating heat in 6 seconds.

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COMPATIBLE STEREOPHONIC SOUND SYSTEM FOR TV

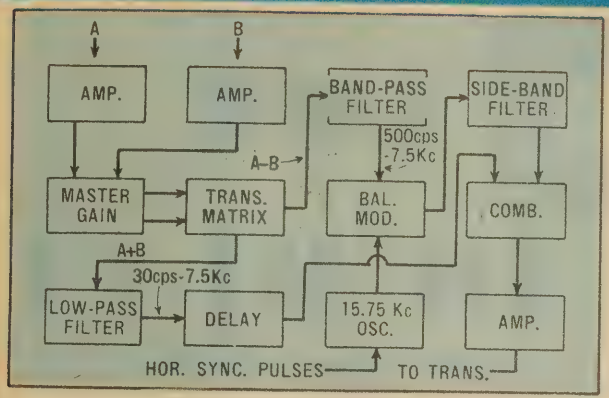


FIGURE 1:—Conventional TV sound transmitter modified for stereo sound transmission.

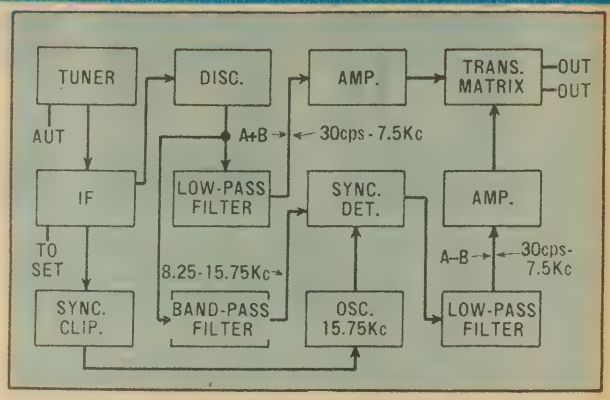


FIGURE 2:—Conventional intercarrier TV receiver for reception of stereo signals.

Multiplexing two separate audio channels at the horizontal pulse frequency permits transmission of stereo over single conventional TV sound transmitter. The result is compatible in that the signal can be heard, as normal, through a standard receiver.

RECENT broadcasting of stereophonic sound for TV programs has required either an A.M. or F.M. station in cooperation with the regular TV sound transmitter. This technique has pointed up the desirability of transmitting stereo without the use of extra transmitters.

The Philco Corporation has conducted a development program to produce a method of single-station stereo sound broadcasting. Two methods of transmission and reception have been developed.

One method uses time multiplexing at the transmitter and receiver; the other, which is simpler, is described in this article. The radiated sound signal is compatible with existing monophonic TV sound and has adequate bandwidth and track separation of the two stereo channels.

The two audio tracks (A and B) pass through conventional 75-usec pre-emphasis circuits and through master gain control to the two-transformer audio matrix as shown in Fig. 1. Sum signal (A + B) is limited to 7.5 kc by a low-pass filter; difference signal (A-B) is limited at both ends of the audio band, 500 cps and 7.5 kc, by a bandpass filter.

BALANCED MODULATOR

Limitation of the low frequencies yields the common low-frequency characteristic of the signal.

A sync separator removes the sync pulses from the composite video signal being supplied to the picture transmitter. The horizontal 15.75-kc sync pulses are used to lock a 15.75-kc sinusoidal oscillator which in turn supplies the carrier to a balanced modulator.

The band-limited difference signal is the other input to the balanced modulator, while the output goes to a lower sideband filter. The filter output is a single-sideband, suppressed-carrier signal in which only the lower sideband of the 15.75-kc carrier exists.

Since the audio frequencies below 500 cps have been eliminated, the linear phase characteristics of the sideband filter may be readily obtained through the useful passband while securing adequate attenuation to the upper sideband.

The single-sideband difference-modulated signal is now combined with the sum signal which goes only through a compensating time delay.

Delay must be added in the path of the sum signal to equalise the delay introduced in the difference path by the single-sideband filter. The stereo signal is amplified and applied to the conventional F.M. sound modulator.

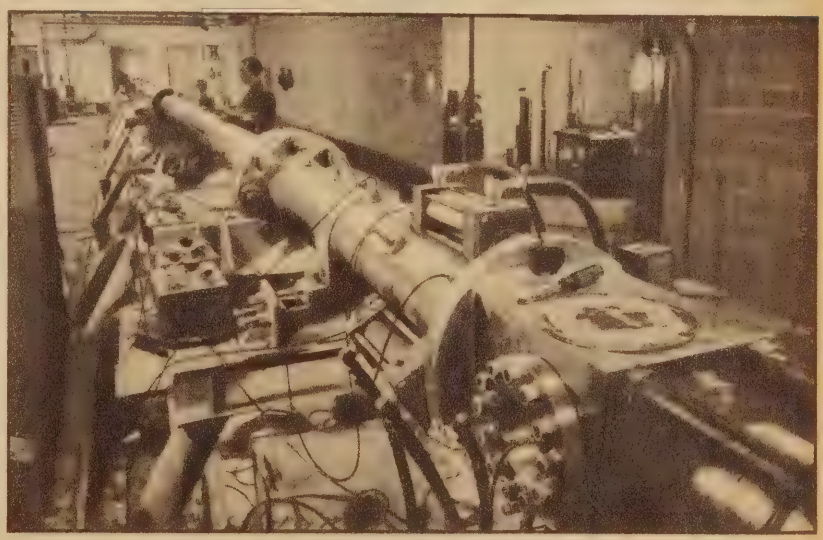
The receiver is a conventional intercarrier type modified as shown in Fig. 2. The composite audio signal is removed from the sound discriminator before the de-emphasis network.

A low-pass filter having a cutoff at 7.5 kc selects the sum signal (A + B) and incorporates a de-emphasis network. A bandpass filter, 8 kc to 15.75 kc, selects the single-sideband suppressed-carrier difference signal (A — B).

The difference signal is recovered by synchronous detection using the 15.75-kc sinusoidal oscillator locked to receive horizontal sync pulses. The output signal is filtered by a low-pass filter and de-emphasis applied.

The amplified sum and difference signals are then combined in a transformer matrix to yield the separate audio tracks. (From "Electronics").

SPACE RE-ENTRY SIMULATOR



This 120-foot shock tunnel specially designed to simulate flight conditions of space re-entry vehicles was recently fired for the 1,000th time in the U.S.A. Heat transfer, pressures, flow characteristics and other aerodynamic phenomena occurring at hypersonic speeds generated by a vehicle re-entering the atmosphere are testd in the shock tunnel. Estimated energy consumption for one firing is equivalent to twelve to fifteen pounds of TNT. According to General Electric, manufacturer of the re-entry portion of the Discoverer satellite and the nose cones for Atlas, Thor and Thor-Able missiles, the firings reproduce conditions of an actual missile flight for nose cone testing.

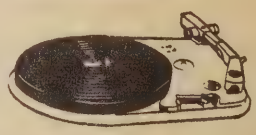
U. R. D. FOR STEREO IN HI-FI

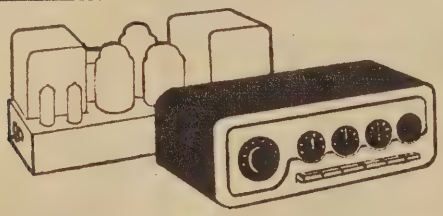
Stereo without High Fidelity is like a picture without colour

DECCA STEREOPHONIC PICK-UP
This pick-up has won incredible world wide acclaim. Fitted with a .0005 diamond stylus, it tracks perfectly at a pressure of 3 grammes. Discs played with it have shown no trace of wear after 120 playings. Produces fine stereo sound, and plays standard L.P. discs perfectly.

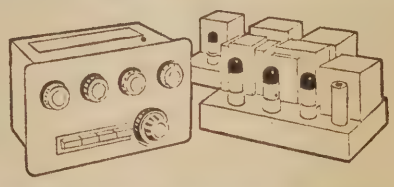
High quality 4-speed single record player at reasonable price. Speed variation ±3%. Fitted with patent automatic stop with provision for disengaging. Plays records up to 16" diameter. Rating 20 watts. Supplied complete with pick-up head, but without cartridge. Head moulding accepts almost any 3-pin cartridge. See also the wonderful Garrard 301 Transcription motor.

GARRARD MODEL 4HF





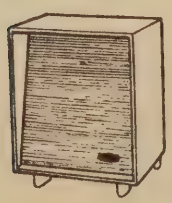
QUAD 22
A development from the world renowned Quad 11, Quad 22 incorporates refinements in design, greater flexibility of input and includes facilities for either stereo or monaural. Operates from discs, tape, radio or microphone, single channel or stereo. Power output: 15 watts throughout the range 20-20,000 c/s.



ROGERS R.D. JUNIOR AMPLIFIER AND STEREO-CONTROL UNIT.
This entirely new unit incorporates every essential for High-Fidelity reproduction from tape, records or radio. Can also be used for monaural recordings. The control unit may be used with two R.D. Junior amplifiers (20 watts output), or two R.D. Cadets (10 watts output), or one of each!

GOODMANS

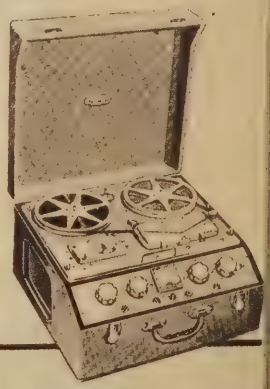
SPEAKERS AND CABINETS



Whatever your requirement in speakers or cabinets, the Goodmans range has the perfect answer. From the new Aixiette II—the ideal choice for Hi-Fi stereo on a budget—to the Audiom series of bass speakers, Midax 950 mid-frequency to the brand new Trebax 35 x L tweeter. And in single unit systems, nothing beats the Axiom 300 or the amazing new Triaxiom 615.

FERROGRAPH SERIES 4
In this new development of the incomparable Ferrograph series, there are eight important design improvements. Every Series 4 is readily adaptable for a variety of applications. For example, the new head cover permits many head changes and additions. Also Series 4A is easily converted to a Series 4S merely by plugging in additional stereo head.

Series 4A/N, 4S/H: 3¾ x 7½ i.p.s.
Series 4A/H, 4S/H: 7½ x 15 i.p.s.
Stere-od unit as required.



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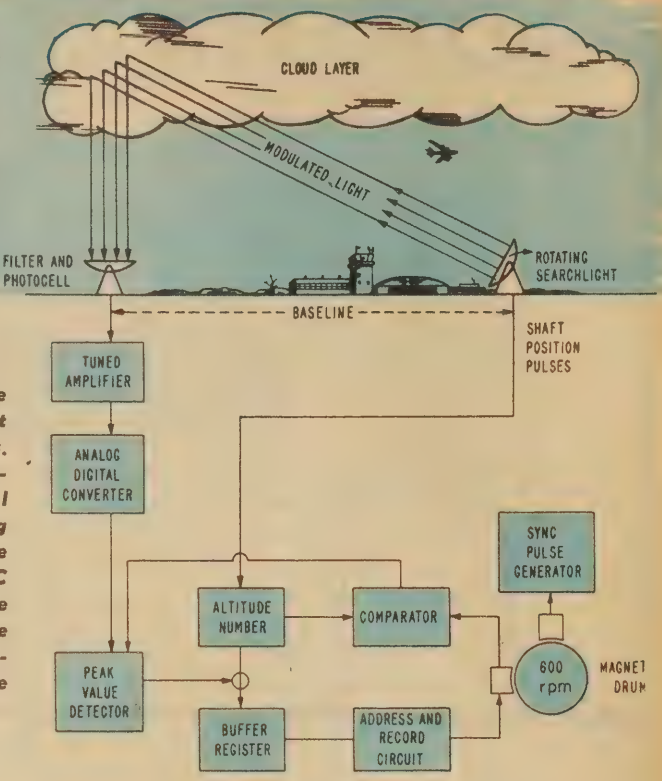
MACHINE RECORDS, CLASSIFIES CLOUD HEIGHT DATA

The U.S. National Bureau of Standards has developed a special-purpose computer for the Weather Bureau to analyse data received from a ceilometer, or cloud-height indicator. On command, this small-scale data processor will tell an operator not only what the cloud height is at present but what the highest, lowest, or predominant cloud height was at any time in the last 10 minutes, or how often clouds occurred below some critical level during this same period.



THE instrument was developed by J. A. Cunningham and Paul Meissner f the data processing system laboratory s part of a program to assist and advise he Weather Bureau in applying compu-er techniques to automatic weather data nalysis.

Cloud height is obtained by means of device known as a ceilometer that can neasure the height of clouds from the round up to about 10,000ft.

A light beam from a searchlight is eflected by the clouds and is received y a photocell placed at a known hori-ontal distance from the searchlight. Either the light or the photocell is rotat-d through an angle of 90 degrees.

TRIANGULATION

The cloud height is calculated by imple triangulation, using the angle at vhich the reflection from the cloud is eceived, and the known baseline.

The light source is modulated by a otating shutter, and the photocell oper-tes in conjunction with a filter and a uned amplifier to discriminate against mbient light. The ceilometer scans he cloud 10 times per minute.

Ceilometer indications are observed by n operator who interprets a cathode-ray lisplay and obtains by manual computa-ion answers to a variety of questions.

Typical questions might be: At what eight did most of the clouds occur over he past 10 minutes (or one minute)? What was the lowest level at which a ignificant number of clouds occurred?

The cloud height data analyser auto-natically finds the answers to these ques-ions, thereby relieving the operator for nore important duties.

To do this, the cloud-height data-nalyser samples the ceilometer output nd records the height at which the great-st signal is received during each scan. These data, which represent the most re-ent 10 minutes of information, are tored in a small 100-word magnetic drum memory.

ANALYSIS PERIOD

After each scanning of the clouds there s a short period of time during which o information is being received; during his time the stored data are analysed. The output of the equipment is a set of nswers pertaining to the last 10 min-utes, updated each scan.

The inputs to the equipment consist f two signals. One is a shaft-position ignal from the rotating searchlight, con-isting of a series of pulses. The other s an A.C. signal from the photocell at he modulation frequency of the light ource.

The shaft position pulses advance an altitude counter whose count is related to the angle of the searchlight. The angle is in turn related to cloud height, which may be as high as 10,000ft.

Inputs to the equipment consist of two signals. One is a shaft-position signal from the rotating searchlight; the other is an AC signal from the photocell at the modulation frequency of the light source.

The photocell signal is passed through an analog-to-digital converter which samples the signal in synchronism with the modulated light source.

At the end of each scan, the equipment has determined the altitude number corresponding to the maximum cloud signal. This number is recorded on the magnetic drum memory in 1 of 100 spaces. The numbers from successive scans occupy consecutive spaces on the drum. The 101st number will replace the original number in space number 1, which was recorded 10 minutes earlier. Thus, the data are continually being updated.

Between scans, the data are summarised to determine which number occurs most often. At the end of this summation, an information storage unit contains the altitude which occurred most frequently over the past 10 minutes.

Other questions can be answered by using counters and additional storage units to find the highest or lowest altitude at which the maximum cloud signal was observed three or more times.

The various outputs from the cloud height equipment are decoded to decimal numbers which are set up as switch contacts to control remote displays and teletype equipment.

Except for the output switches and magnetic drum, the equipment is entirely transistorised and was made almost exclusively digital in operation to assure a high degree of reliability.

ENTIRE NEWSPAPER BY RADIO

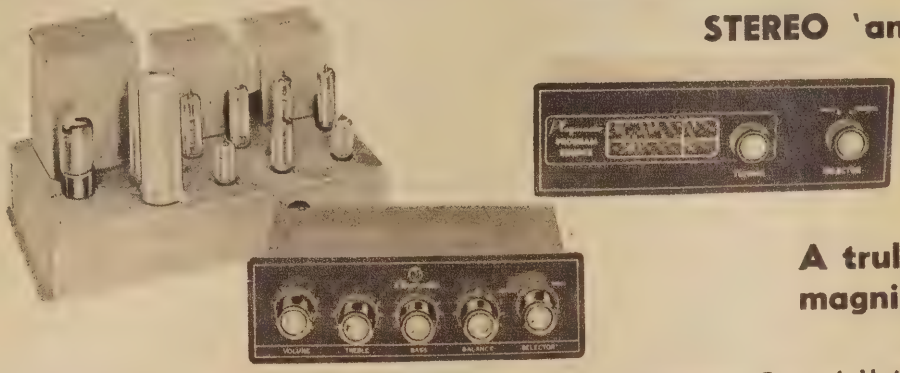
UNTIL recently, Japan's "Asahi Shimbun" had a distribution problem in the northern island of Hokkaido, 500 miles from the head office in Tokyo. Flying newspaper supplies into the island was not always possible and the population usually had to wait for their papers to come by boat and rail, which took nearly two days. With new Muirhead tele-photo apparatus, the "Asahi Shimbun" can now be on the news stands in Sapporo, the biggest place on the island, in just over an hour after it has appeared on the streets in Tokyo.

As each page of type is made up in the head office in Tokyo, a proof is pulled on no more than good quality paper. This is fed into a transmitting cabinet which converts every bit of printed matter into a mass of electronic impulses. All this is then sent off by radio to the office in Sapporo — although it could be sent over a landline if necessary.

On the receiving apparatus at the other end, the signals are changed back into printed matter which emerges from the machine in the form of a photographic negative of each page. The metal printing plates are then made from the negatives and the "Asahi Shimbun" comes pouring off the rotary presses in Sapporo almost before the parent presses in Tokyo have stopped running with the current edition.

SAVE MONEY on finest quality PLAYMASTER hi-fidelity equipment.

STEREO 'and MONO'



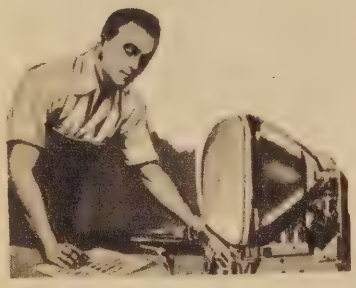
A truly magnificent trio

★ **The Playmaster 10 watt Amplifier (valves or silicon diodes—either version)**
★ **Playmaster Control Unit.**
★ **Playmaster Program Source.**

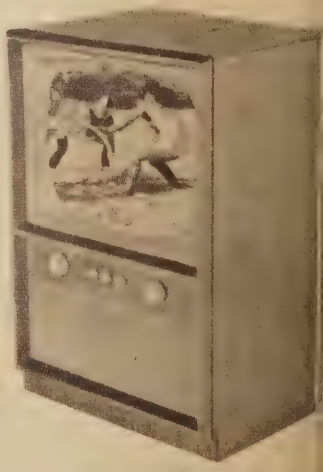
For the discriminating, this Playmaster outfit is available either for stereophonic or monophonic reproduction, in kit form or ready built. Really true fidelity at extremely low cost.

We offer you a complete range of Playmaster amplifiers, control units and tuners, all faithfully to "R., T.V. & H." specifications and design

Send coupon below for your copy of the Playmaster catalogue and price list.



110° TV KIT . . .



Remarkable for its simplicity of layout and efficiency in operation, this is the very simplest possible TV set to build. The kit is complete to the last nut and bolt. Everything is included, ready drilled chassis, picture tube wired, Q+ IF strip matched to Q+ tuner, A.W.A. deflection components and everything best quality fully to "R. T. V. & H." specifications.

FRINGE AREAS. Yes, the kit is available for fringe areas with Q+ Mark 3, four stage IF strip.

CABINETS We offer you the choice of a high quality, fully veneered cabinet or a kit of parts to build your own.

LOW COST. The cost of the kit is amazingly low, and furthermore, we deliver free to capital cities.

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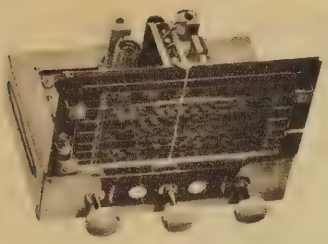
ADDRESS .....

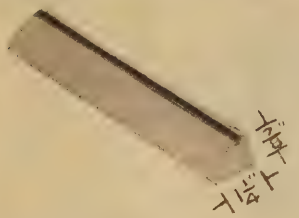
ELECTRONIC



Playmaster Dual Wave Tuner. Available with power supply and tuning indicator.

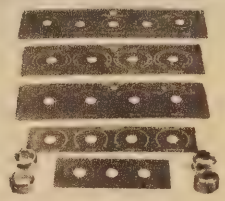
Playmaster control unit boxes, ready drilled complete with front panels and brackets. High quality hammertone finish. Full range of Playmaster amplifier and tuner chassis also available.

Kits of parts available to make your own hi-fi equipment cabinet and 12in speaker enclosure. All panels precision cut from solid 7/8in selected timber.

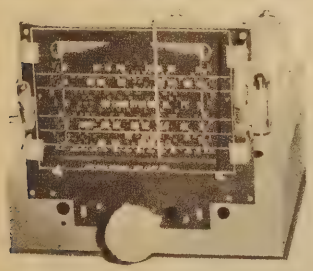


High-grade timber moulding, complete with gold coloured metal insert. Same type as used on highest quality TV cabinets.

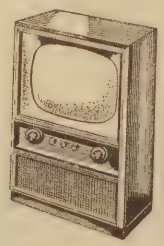
Complete kits plus ALL accessories and spares for the "R, TV and H" TV Sets and Playmaster Hi-fi equipment.



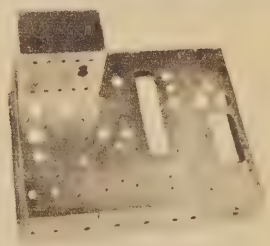
Anodised metal labels to suit various Playmaster amplifiers, control units, and program source. Mono' labels, maroon background with silver lettering. Stereo coffee brown and gold. Beautiful knobs with gold metal centres to match.



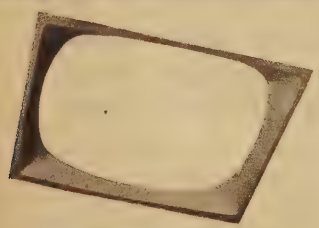
Some very fine hi-fi tuners are included in the Playmaster range. See Playmaster specification sheets for full details.



Timber kits to construct the 110 degree TV cabinet. Everything precision cut. All parts included, glass, mask, beading, gold insert, speaker grille, etc.



TV chassis, specially made for "R.T.V. and H." 110 degree circuit. Cadmium plated, and then passivated to avoid fingermarks. Complete with E.H.T. box, and all holes drilled.



The very best plastic TV masks as used on the finest commercial sets. 21in and 17in. Also available metal reducing mask, hammertone finish to enable 17in set to fit in 21in cabinet.

Q plus Mark V I.F. strip, ready wired and aligned for the 110 degree TV set. If purchased with the Q plus tuner, we will supply them matched.
For fringe areas Q plus Mark III and IV I.F. strips are available.

Set of 5 high-quality TV knobs for 110 degree TV set. In coffee brown or ivory, with attractive gold coloured, trim station numbers on tuning knob.

PARTS Pty. Ltd.

E. S. & A. BANK BUILDING, 206 BROADWAY, NSW
(opp. GRACE BROS.) PHONES BA4891, BA4892-3.

PHILIPS STEREO

Record Changers and Record Players

TYPE NG1020

Triple-Function STEREO Record Changer

Now produced specifically for stereo operation, the popular Philips push-button record changer fulfils the exacting demands of this exciting new development in record reproduction.

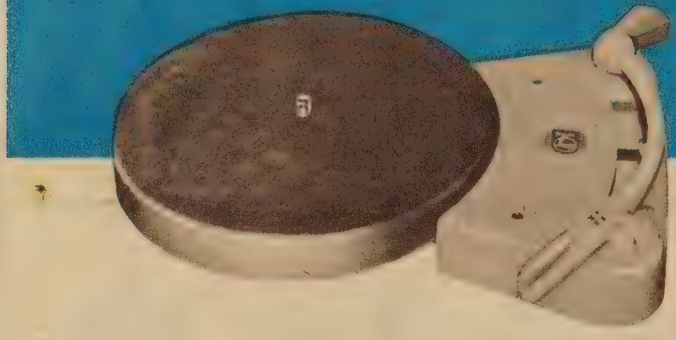
- Two separate plug-in high-fidelity pick-up heads: L.P. and Stereo type AG 3063; 78 r.p.m. type AG 3066.
- Plays all types and sizes of records—Stereo, L.P., 78, 45, 33⅓, 16⅔.
- Push-buttons for easy operation.
- Smooth, silent, wow and flutter free, absolute minimum rumble.

Three separate functions.

1. Fully automatic changer—loads up to ten records.
2. Automatic single play. Single records may be placed directly on the turntable.
3. Manual single play.

21 GNS.

PHILIPS



TYPE NG1009

A.C. Player with Stereo Counterweight and Stereo Pick-up Head

A pick-up arm counterweight is now available as an accessory for the popular Philips four-speed record player. With the stereo pick-up head plugged in, the counterweight reduces the needle pressure to the correct amount for playing stereo recordings. This removes the need to use inaccurate spring devices and the unit provides a compact stereo player for the widest applications.

NG1009—A.C. player with standard twin stylus pick-up head **£10-9-0**

AG3063—Stereo pick-up head **£2-7-6**

NG1023—Stereo counterweight **10-6**

Mounting plate **15-6**

NG1012—6-volt battery-operated version of record player **£13-5-0**

P1651.59

PHILIPS ELECTRICAL INDUSTRIES PTY. LTD.

Sydney • Melbourne • Brisbane • Adelaide • Perth • Hobart

NEWS AND VIEWS OF THE MONTH

New ramjet

A MAJOR breakthrough in the ramjet engine field was announced recently by the Boeing Wichita Division. The company applied for patent on the design of a ramjet capable of propelling an aircraft or missile 16 times the speed of sound. The engine would operate within the atmosphere, between 4,000 and 11,000 miles per hour, probably using hydrogen for fuel. The engine, still in the drawing-board stage, has no immediate application.

Novel feature of the new ramjet is that combustion can take place at supersonic speeds within the engine. It has these advantages: simplification of supersonic inlets, reduction of engine weight, achievement of maximum energy release rate, increase in engine thrust to weight ratios and elimination of the ignition system.

★ ★ ★

Who's looking

STAFF engineer of N.B.C., Jarrett L. Hathaway, has registered some 30 patents in the broadcasting field in the past 30 years. His most recent invention is a system for finding out how many television sets are tuned to which programs at any hour of the day. His method uses a truck with receiving equipment which can detect radiation from home receivers and compare it with radiation from a number of local TV stations. By driving down the street in anybody's home town, the truck can tell who's looking at what.

Mr Hathaway's detector may provide broadcasters and advertisers with a new, scientific method for determining how big an audience they have.

★ ★ ★

Mobile showroom

AFTER completing a 4,000-mile tour through five countries in Western Europe, a mobile demonstration unit, equipped with the latest E.M.I. machine tool control systems and other automation aids, returned to the United Kingdom recently.

Countries visited included France, Holland, Germany, Switzerland and Belgium.

The trailer, fitted out as a complete modern workshop, had its own closed-circuit television system, on which visitors seated in a reception area were able to see the demonstrations being given.

Particular interest was aroused by the large Kearney and Trecker milling machine of an entirely new design, which carried out complex operations in two and three dimensions controlled entirely from punched tape.

Among orders received as a result of the operation is one from Switzerland for one of E.M.I.'s new Commutator Undercutting machines. This machine enables segments in a small electric motor commutator to be undercut automatically to high degrees of accuracy.

From Belgium came an order for one of the latest high precision O.M.T. rotary table positioning systems. This system, which can be used in conjunction with a wide variety of machine tools, is already being used successfully by Rolls-Royce in the U.K.

★ ★ ★

Aid for patients

ONLY those who have been seriously ill appreciate the relief of being able to turn from one side to the other in bed without help. In hospital, the task of seeing that weak and paralysed patients are kept free from the discomfort and the ill effects of lying too long in the same position is one that takes up a great deal of nursing care and valuable time.

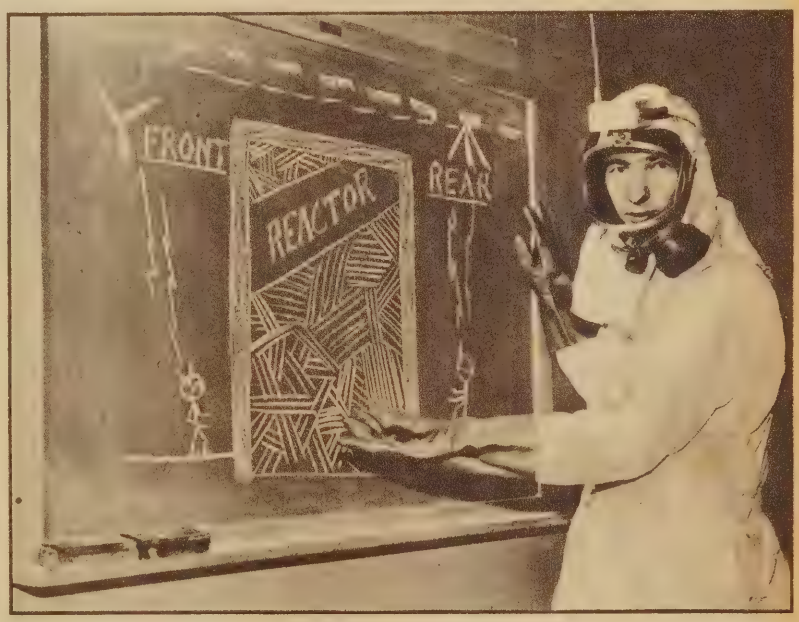
A new and very simple device invented by a British doctor, Dr E. A. Cooper, makes it possible for one nurse working alone to turn a patient from one side to the other in bed with complete safety, even if the patient is unconscious, or so weak that turning by hand would be out of the question.

Between the bottom sheet and blanket and the mattress are placed two long, narrow air cushions, which can be inflated separately to hold the amounts of air required at any given time. The patient has one of these cushions under either side of his spine.

By gently increasing the air in one cushion and decreasing it in the other, the weight of the patient's limbs is slowly and automatically moved in the right direction. Later, when a change of posi-

THEY TALK THROUGH THEIR HATS

How to talk your way around a huge nuclear reactor is demonstrated by General Electric engineer Neil Iverson at the U.S. Atomic Energy Commission's (AEC) Hanford plant.



Iverson built two-way radio headsets into protective masks to improve communication between atomic workers located on front and rear sides of a production reactor during fuel loading and unloading.

Uranium fuel elements are loaded at the front of the reactor and discharged from the rear face, after being irradiated in the plutonium production process.

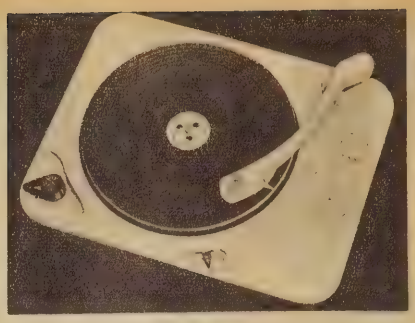
Because the rear face is sealed off from the rest of the building by a thick mass of high-density concrete, some type of electronic communication system must be used.

Signals from the built-in radio are picked up by antenna in the ceiling of the reactor rear face area, carried by coaxial cable around the concrete shielding to the front face, where they are broadcast from another antenna on the wall.

Persons in the front face area or in the control room can talk with those in the rear face area over the system.

Chief advantage is in the time saved, since the period workers in the rear face area can remain on the job is limited to protect them from any potential overdose of radiation. Protective masks and clothing are worn to keep out radioactive contamination.

A PICTURE OF EXCEPTIONAL VALUE



Yes, undoubtedly the best value in record playing equipment available today . . . The new Thorens TD-134 player.

Here is a 4 speed belt drive turntable, with rumble, wow, and flutter figures equal to the best high priced units, speeds variable plus or minus 3%, fitted with a tone arm of superior quality, featuring a wide adjustment of weight, 5 pin connection universal plug-in shells and capable of operating at 2½ grams tracking pressures.
Yet with all these features, this unit only costs £35/10/ — truly exceptional value.

Also available: the model TD-184L, featuring the same turntable and pickup combination, but having, in addition, the exclusive Dial-O-Matic system of arm control — one dialling motion selects record size and starts motor, arm floats down on a cushion of air, and is **completely disengaged** during playing. £43/10/. No matter what other equipment you use, we guarantee these players to give cleaner and better listening.

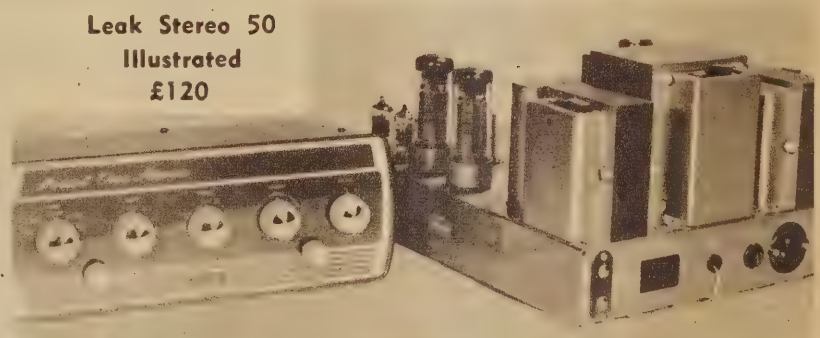
ARROW ELECTRONICS PTY. LTD.

offer a full range of components for stereo and mono systems.

AMPLIFIERS

Quad Stereo Preamp	£64 15 0
Quad Power Amplifier	£61 5 0
Aegis 6-88 Stereo Amplifier	£59 17 6
Astronic A1444 Stereo Amplifier	58 18 0
Grampian 590/1 mono	58 5 0
Grampian 590/2 Stereo	91 0 0
Leak Stereo Preamp	60 0 0
Leak Stereo 20	87 0 0

Leak Stereo 50 Illustrated £120



LOUDSPEAKERS

We have a full stock of the Goodmans range, including the new Trebax complete with crossover network and attenuator £17/5/.

Wharfedale

Super 3	£13 12 4
Bronze 8in FS/AL	7 5 10
Super 8FS	13 0 3
10in Bronze	11 0 0
Super 8 FS/AL	13 12 4
Golden FSB 10in	17 2 9
W12 FS	28 1 9
Column 8/145	15 10 6
Super 12 FS AL	44 3 7
Co-axial 12	64 0 0

Good bass from small enclosures? Certainly. The new Wharfedale compact systems, model W2, W3, and W4 present a new outlook in the design of full range small size speaker systems. Further details on request.

CABINETS, CABINET KITS

8in enclosure model AK8M unpolished, maple veneer timber 9 7 6
Kit: 6 14 6
12in R.J. enclosure, as above, complete 12 13 0
Kit: 8 16 0
Sherwood enclosure, polished and complete with grille cloth and legs 25 19 6
Sherwood kit, in maple or walnut veneer, less legs and speaker cloth 14 8 0
All the above kits are ready for assembly, and include all necessary nails, screws, etc.

PICKUP CARTRIDGES

Ronette Stereo crystal BF40 with sapphire stylus. £4/5/6. Ronette stereo turnover with 2 sapphire styli, £4/12/6. General Electric 4G052 mono diamond LP and sapphire 78, £13/16/. VR227, diamond .7 mil (compatible), £18. VR225 .5 mil diamond (professional stereo).

ORTOFON PICKUPS

We have a full range of Ortofon pick-ups and accessories, in both 12in and 16in arms, with mono or stereo cartridges, transformers, etc. Complete pick-ups from £18.

For all your tape recorder requirements, recording tapes and accessories or for tape recorders generally why not see us first? We have stocks available of all popular models both mono and stereo and carry full stocks of all auxilary equipment.

The new BSR TD1 tape deck is now available and is designed for single speed operation with 5½in spools, automatic record safety protection built in, fast forward and rewind.

REMEMBER our stocks cover all your requirements. No matter what you need from stylii to speaker cloth, we can supply. Write or phone us first.

ARROW ELECTRONICS PTY. LTD.

422 KENT STREET, SYDNEY. BX6731

tion is desirable, all that need be done is to repeat the air-filling and extracting from the cushions in reverse.

It has been found quite possible for weak patients who are not seriously ill to operate it for themselves.

★ ★ ★

New power stations

THE first of two 100,000 kilowatt electric generators—the largest to operate in Australia—will be commissioned at Tallawarra Power Station, near Port Kembla, N.S.W., during 1960.

At Wangi Power Station (on Lake Macquarie) the last of six generating units will be installed, while a new section of Wallerawang Power Station (near Lithgow) will be opened about the end of the year.

These three major new steam stations have been built by the Electricity Commission on the N.S.W. coalfields for the economic production of large quantities of electricity for the State supply system.

★ ★ ★

TV "too good"

THE only problem of watching television 30,000ft above the earth is that reception is so good that the programs of widely separated stations using the same frequency occasionally overlap. Normally the picture from a station as far away as 200 miles comes in bright and clear on TV sets installed in Continental Airline's Golden Jet Boeing 707s.

Each of these luxurious jet airliners, flying between Los Angeles and Chicago nonstop or with a single stop at either Denver or Kansas City, has a television set in the forward first-class lounge. The sets are portable and weigh about 40lb each.

Continental solved the aerial problem by faring it into the upper tip of the Golden Jet's tail. Network programs, such as one of the "bowl" football games, are favoured. But even the serene, purplish sky at 30,000ft sometimes is invaded by gun-slinging cowboys on their galloping steeds.

★ ★ ★

R.C.A.'s coaxial cable

R.C.A. Communications, Inc., plans to supplement its global radio communications network with transatlantic coaxial cable channels.

The company has asked the Federal Communications Commission to authorise the arrangements. Approval would open the way for R.C.A. to expand its international telegraph, telex and leased-channel facilities between the United States and Europe.

Mr T. H. Mitchell, company president, said the public demand for international telegraph service of every kind is growing steadily throughout the world.

"By using coaxial cables to supplement radio in future transatlantic expansion," he said, "R.C.A. Communications will be able to conserve radio frequencies and provide additional facilities in those areas of the world where radio is the sole means of international communications."

Mr Mitchell said the plans call for R.C.A. to operate the western end of the cables, while the British Post-Office, the French Ministry of Posts, Telegraphs and Telephones and the Deutschepost in Germany will operate the European ends.

BOOKS & MAGAZINES

(See also our other Advertisement in this issue)

RADIO VALVE DATA (6th Edition)—characteristics of 3,000 tubes, transistors, rectifiers and CR tubes. Over 130 pages. **PRICE:** 9/3 (N.Z. 7/6).

MULLARD CIRCUITS FOR AUDIO AMPLIFIERS—see review P.91, Sept. R., TV and H. Special free brochure available on request. **PRICE: 13/9, incl. postage** (N.Z. 11/).

HIGH-FIDELITY SOUND REPRODUCTION—special free brochure available on request. **PRICE:** 33/3 (N.Z. 26/7).

LOUDSPEAKERS—by G. A. Briggs, the Wharfedale Speaker man. **PRICE: 29/6** (N.Z. 23/9).

A FIRST COURSE IN WIRELESS—The book for beginners. **PRICE: 19/9** (N.Z. 16/).

ELEMENTARY MATHEMATICS. PRICE: 21/3 (N.Z. 17/).

ELECTRONIC HOBBYISTS' HANDBOOK. PRICE: 25/9 (N.Z. 20/7).

ELEMENTS OF TAPE RECORDER CIRCUITS—A thorough treatise on tape recording, and invaluable to anyone wanting to build their own. This is quite the most outstanding book in this field, we consider. **PRICE:** 29/9 (N.Z. 23/10).

101 WAYS TO USE YOUR SWEEP GENERATOR. PRICE: 20/9 (N.Z. 16/7).

BASIC RADIO COURSE—by John T. Frye (the American slant on learning radio). **PRICE:** 23/3 (N.Z. 18/7).

NEW BOOKS FROM AMERICA—never before advertised in these columns

STEREO—HOW IT WORKS. Send for special free brochure. PRICE: 29/9 (N.Z. 23/10).
PRINTED CIRCUITS. See review P. 71 "R., TV & H.", Jany. Also send for our special free brochure. PRICE: 29/9 (N.Z. 23/10).
101 WAYS TO USE YOUR V.O.M. and V.T.V.M.. PRICE: 20/9 (N.Z. 16/7).
101 WAYS TO USE YOUR SIGNAL GENERATOR. PRICE: 20/9 (N.Z. 16/7).
101 WAYS TO USE YOUR OSCILLOSCOPE. PRICE: 25/9 (N.Z. 20/7)
101 WAYS TO USE AUDIO TEST EQUIPMENT. PRICE: 20/9 (N.Z. 16/7).
A.B.C.'s of TRANSISTORS. Reviewed P. 71, Jany., "R., TV & H." We have a limited supply only at present. PRICE: 13/ (N.Z. 10/5).
RAPID TV REPAIR—by G. W. Heath. Plenty of copies available. PRICE: 29/9 (N.Z. 23/10).
AUDIO DESIGN HANDBOOK — by H. A. Hartley PRICE: 29/9 (N.Z. 23/10).

OTHER AMERICAN BOOKS WHICH HAVE BEEN GOOD SELLERS

TV—IT'S A CINCH! Presented in an easy-to-understand, conversational style—after the manner of "Here's your answer, Tom." **PRICE: 29/9** (N.Z. 23/10).
SERVICING TRANSISTOR RADIOS—by L. D'Airo. Special, free brochure available on this book. **PRICE:** 29/9 (N.Z. 23/10).
RAPID RADIO REPAIR; OSCILLOSCOPE TECHNIQUES. Both of these reviewed on P. 71, Jany., "R., TV & H." Each is priced at 29/9 (N.Z. 23/10).
MODEL RADIO-CONTROL by E. L. Safford. Special brochure available on request. Also see review P. 91 Sept. "R., TV & H." PRICE: 27/3 (N.Z. 21/9).
SERVICING RECORD CHANGERS. PRICE: 29/9 (N.Z. 23/10).
TV REPAIR TECHNIQUES. PRICE: 15/6 (N.Z. 12/5).
KNOW YOUR OSCILLOSCOPE. PRICE: 20/9 (N.Z. 16/7).

Coming late March! We have hundreds of copies of the 1960 Edition of radio's classic work, **THE RADIO AMATEUR'S HANDBOOK,** on their way. We have bought in quantity, and can offer this issue at **46/6** per copy. (N.Z. 37/6.) Order now . . . Please note that we have a few copies of last year's Edition, with very slightly damaged covers, available for **38/** each.

POPULAR MAGAZINE SUBSCRIPTIONS

The following are MONTHLY magazines, the prices being for one year's supply. Send us your payment for the amount shown, and we will arrange, promptly, for your copy to be mailed direct from the publishers the day it comes off the press. We guarantee delivery . . . Please note several **price changes,** including "R., TV & H," all effective from 1/3/60.

AMATEUR RADIO—Australia's own monthly magazine for the ham and would-be ham.	24/	(N.Z. 19/3).
AUDIO (U.S.A.)	45/	(N.Z. 36/).
CQ (U.S.A.)	54/	(N.Z. 43/3).
HI-FI NEWS (This is an absolutely first-rate paper for the Hi-Fi fan) (U.K.).	39/6	(N.Z. 32/).
POPULAR MECHANICS (U.S.A.)	40/6	(N.Z. 32/6).
POPULAR SCIENCE (U.S.A.)	54/	(N.Z. 43/3).
PRACTICAL TELEVISION (U.K.)	25/9	(N.Z. 20/3).
PRACTICAL WIRELESS (U.K.)	27/	(N.Z. 21/6).
QST (U.S.A.)	54/	(N.Z. 43/3).
THE RADIO CONSTRUCTOR (U.K.)	32/	(N.Z. 26/).
RADIO ELECTRONICS (U.S.A.)	49/6	(N.Z. 40/).
RADIO, TV & HOBBIES (increased from this issue)	35/	(N.Z. 28/).
THE TAPE RECORDER (U.K.)—this is proving a very popular magazine, indeed.	30/	(N.Z. 24/).
WIRELESS WORLD (U.K.)	44/	(N.Z. 35/).

Also we can get you all types of magazines—not necessarily radio and TV or mechanics books. Please ask for our quotation. Others being requested are, for example, NATIONAL GEOGRAPHIC (U.S.A.) 85/6 (N.Z. 68/), THE GRAMOPHONE (U.K.) 32/6 (N.Z. 26/), AUTOMOBILE ENGINEERING (U.K.) 75/6 (N.Z. 60/6), BASEBALL DIGEST 27/6 (N.Z. 22/).

NEW ZEALANDERS! You may buy our books by sending us your usual cheque, or else a money order payable at Auckland, for the amounts shown. We will post your order from Australia, crediting your payment to our bank account in Auckland.

ATTENTION! SEE ALSO OUR OTHER 2/3 PAGE ADVERTISEMENT IN THIS ISSUE.
NOTE . . . The prices we quote are those set by The Australian Booksellers' Association—the price-fixing authority for all books sold in Australia. Please pay by cheque or money order—do NOT send cash.

ELECTRONICS PUBLICATIONS

(AUSTRALIA)

A Division of The Electronic Organ Company (Australia).

11 CADOW STREET, PYMBLE, N.S.W., AUSTRALIA

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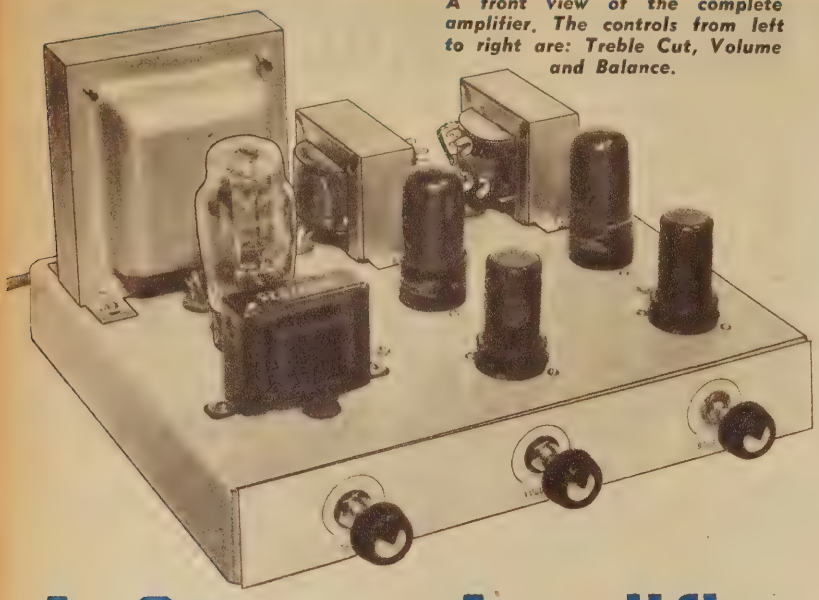


A front view of the complete amplifier. The controls from left to right are: Treble Cut, Volume and Balance.

A Stereo Amplifier from oddment parts

Perhaps you've wished to join the ranks of the stereo enthusiasts but have thus far considered it too costly or too difficult. This new amplifier will give you a good stereo system at a moderate cost, with many of the components taken from the "junk box," or bought cheaply from surplus stocks.

By Wes Yashin

DURING the past few months we have described a number of stereo amplifiers and a complete stereo radiogram. All these proved popular and satisfied a definite demand.

Although these units varied in cost and complexity, they were all designed around currently available components, with their trend toward miniaturisation. Naturally, the chassis space was limited to the needs of such components, without regard to the larger, old-style components that many of us still have on hand.

But not all of us have the means (or the need) to purchase a complete new kit of parts. Many would probably settle for more or less conventional equipment, as used in standard radiograms, with a modest output, and which, above all, does not cost too much

Primarily, the present amplifier design is aimed at this group of readers, but, at the same time, there is no reason why better quality output transformers, speakers and pickups may not be used to give you sound quality from it, which compares favourably with the better class combinations—or more than favourably with conventional commercial radiograms.

VIRTUES OF STEREO

In this instance, our prime requirement is the enjoyment of the stereo effect, with the best possible frequency response and the least possible distortion. The virtue of stereo lies in the fact that, with two channels, even though they are simple, it is possible to achieve an effect of perspective which is impossible with only one channel.

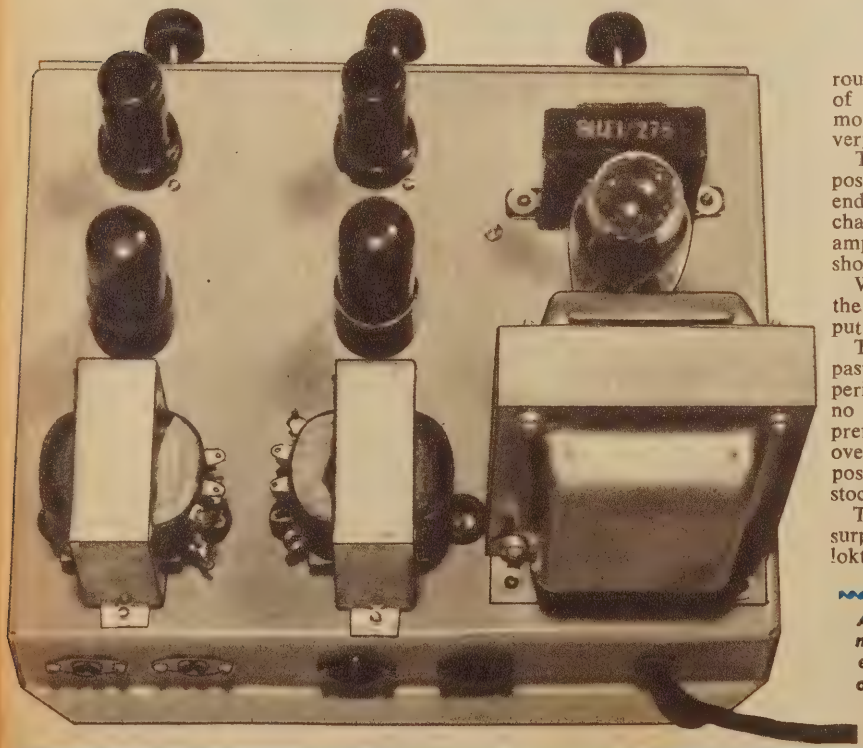
Past experience has shown that, for routine domestic listening, two channels of 4 or 5 watts each is adequate for most purposes, the full output being very rarely used.

Thus, almost automatically, the proposed circuit boiled down to two single-ended channels, using two valves per channel, an output stage and a voltage amplifier. Further, that these valves should be conventional octal-based types.

We reasoned that the 6V6 would be the obvious first choice for the two output stages.

The valve has been widely used in the past and is the one most likely for experimenters to have on hand. Although no longer on the valve manufacturer's preferred list, it may still be purchased over the counter for replacement purposes and often turns up in surplus stocks.

The 7C5, which has also featured in surplus stocks, and very cheaply, is a loktal-based version of the 6V6. It could



A view showing the layout of the major components. Along the rear edge are the two input sockets on the left, followed by the two output sockets to the right.

CAN USE A VARIETY OF VALVES AND COMPONENTS

PARTS LIST

1 Chassis 11 x 9¼ x 1¾ (or to suit parts available).
1 Power transformer, 285 volts per side at 100 mA.
1 Filter choke, 100 mA or larger (see text).
2 Output transformers (see text).
5 Octal sockets.
2 4-pin miniature plugs and sockets.
2 Utilux input connectors.

VALVES

1 5V4G,
2 6V6GT,
2 6SH7. (For possible substitutes, see text).

CAPACITORS

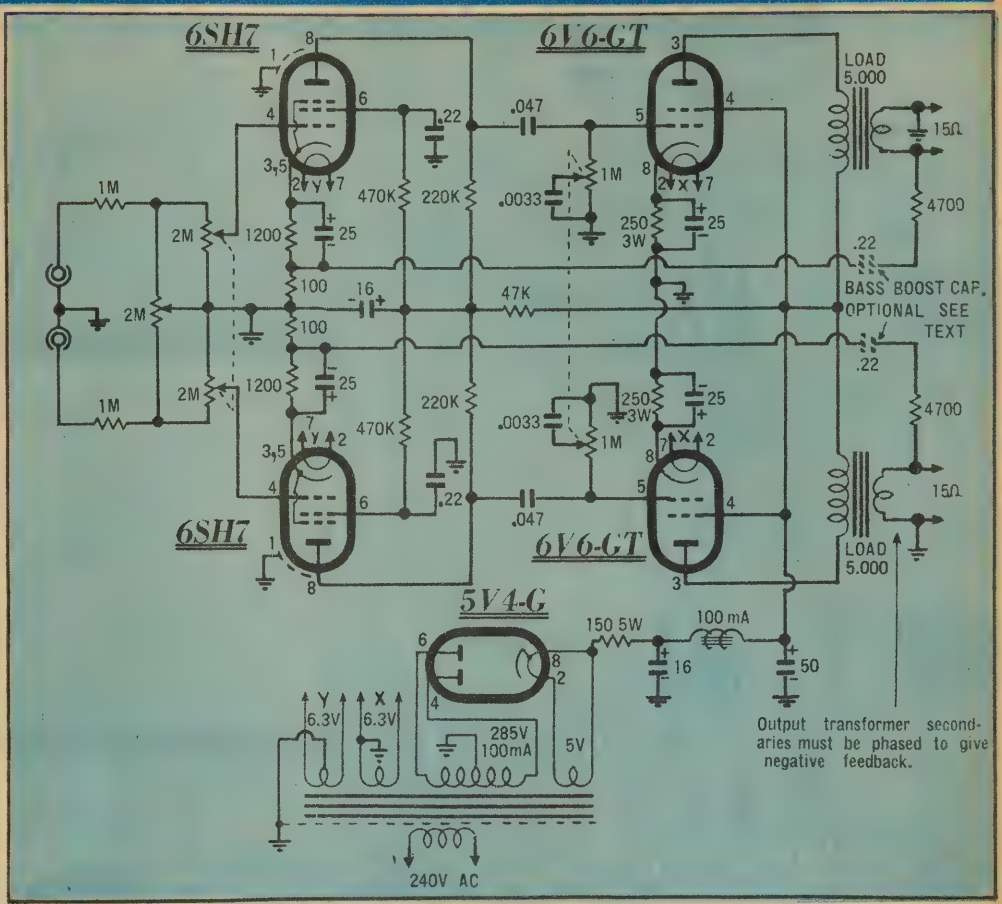
1 50 mfd 350 volt electro.
2 16 mfd 350 volt electro.
2 25 mfd 40 volt electro.
2 25 mfd 12 volt electro.
2 .22 mfd 400 volt paper.
2 .047 mfd 400 volt paper.
2 .01 mfd paper or ceramic.

RESISTORS

2 1meg ½ watt.
2 470K ½ watt.
2 220K ½ watt.
2 1200 ohm ½ watt.
2 4700 ohm ½ watt.
2 100 ohm ½ watt.
1 47K 1 watt.
2 250 ohm 3 watt.
1 150 ohm 5 watt.
1 2 meg potentiometer.
1 2 x 2 meg ganged potentiometer.
1 1 x 1 meg ganged potentiometer.

Sundries.

Nuts and bolts, solder lugs, 8" length of component strip, 1 3-lug mounting strip, 1 2-lug mounting strip, coaxial cable, hookup wire, tinned copper wire, spaghetti, 3 knobs, 3 core flex and plug.



be substituted without change to the electrical circuit.

In the miniature series of valves, the 6AQ5 and 6BW6 may, for the present purpose, likewise be considered as electrically identical to the 6V6 and could be used for one or both channels.

Selection of an output or speaker transformer with the correct primary impedance should not present any problems, a figure of 5,000 ohms being required by all the aforementioned types. In practice, anything from about 4,000 to 7,000 ohms should be quite satisfactory.

ALTERNATIVE VALVES

Other valves, of course, could be used in the output stage. Among the older types, the 41, 42 and 6F6 suggest themselves. They rightly should be used with an output load of 7,000 ohms and would need a bias resistor of about 400 ohms.

For the voltage amplifier we have suggested a 6SH7, mainly because the valves have been—and still are—available in large numbers and cheaply from disposals sources.

Alternatively, you may have a couple of 6AU6 valves on hand. This is a 7-pin miniature type, but it happens to be equivalent electrically to the 6SH7.

Actually a wide variety of sharp cut-off pentodes have been available as, for example, the 6C6, 6J7-G, 6SJ7, etc. Any one of these could be used with only a slight loss in gain. We suggest increasing the screen supply resistor to 1 megohm for these types.

The circuit is simple and non-critical. The voltage amplifier operates with a gain of about 200, which figure is reduced by the application of feedback. The net result is an input sensitivity suitable for current stereo crystal pick-ups. It is not necessary to use a high output type.

Coming to the power supply, you will note that it is quite straightforward. A 285-volt per side, 100mA power transformer supplies the necessary voltages. The 100mA. rating is just adequate for the amplifier, and those wishing to provide for a tuner as well will need a 125mA. transformer.

Almost any existing transformer could be pressed into service, there being adequate space on the chassis for all but the largest types.

The filter choke may be any type which will fit on the chassis and having a current rating of 100mA. or higher. The one used in the prototype amplifier is actually a 1 henry television type, which is currently available quite cheaply. The type of choke used will have a bearing on the final H.T. voltage by reason of its DC resistance.

The rectifier we used is a type 5V4, mainly because it happened to be on hand and because, being an indirectly heated type with a slower warm-up period, it does not produce high peak output voltages. This allows the use of lower voltage electrolytics.

USE OF DROPPING RESISTOR

Actually, due to its lower internal resistance, its DC output voltage is slightly too high for our requirements and we have included a small dropping resistor between the cathode and the first filter capacitor.

There is no special reason, however, why a directly heated rectifier such as the 5Y3, should not be used. With this valve the dropping resistor may be dispensed with, but the ability of the

Dual

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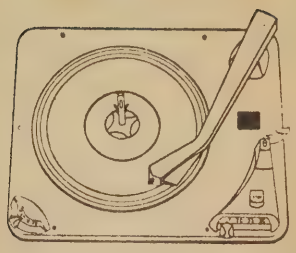
1007



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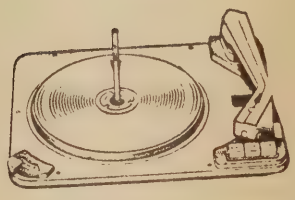

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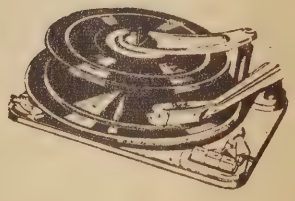
1004S



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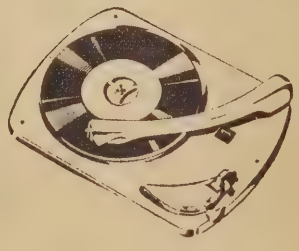
300



With Stereo Cart. £21/5/-

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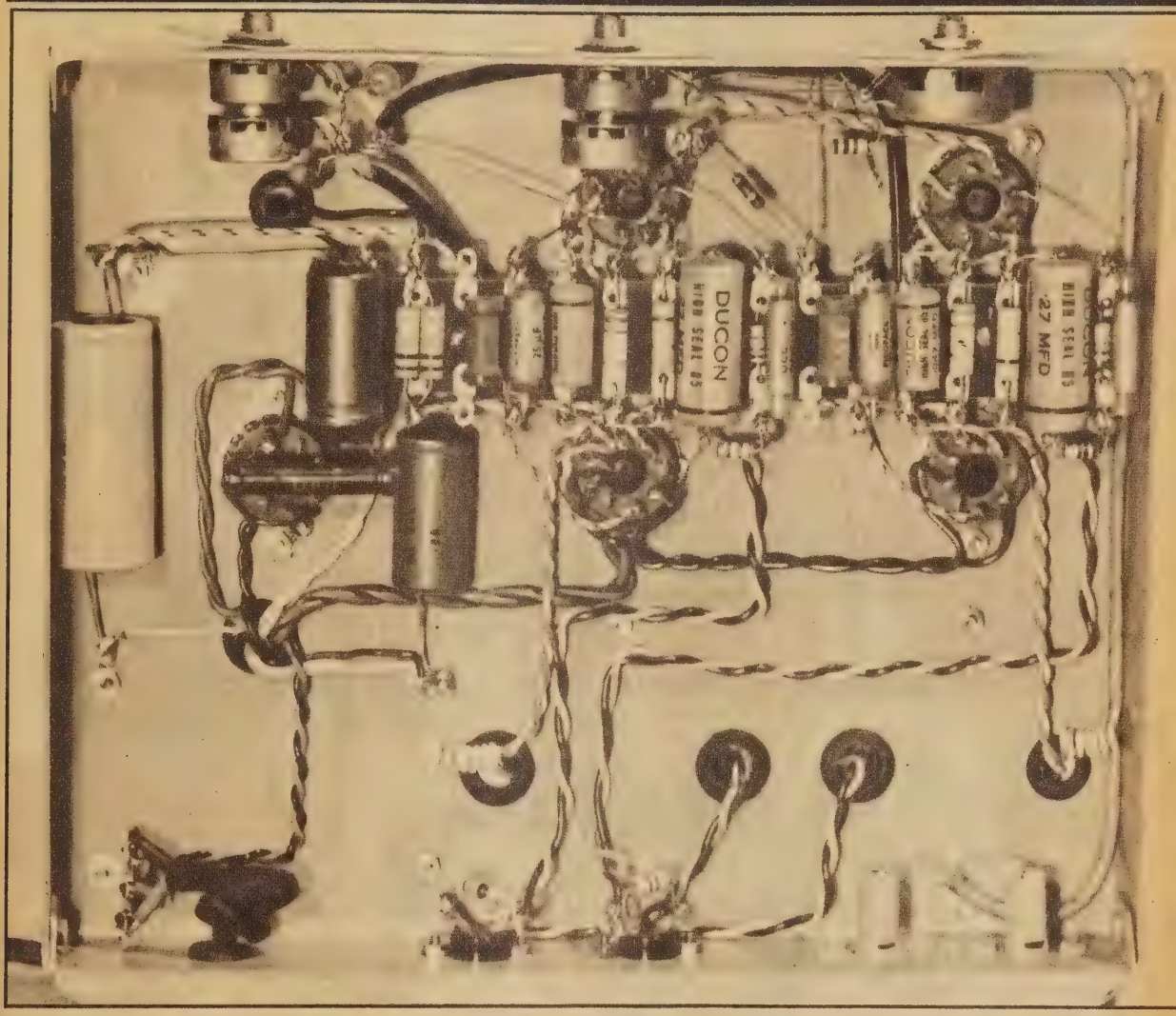
UNDERNEATH VIEW OF THE AMPLIFIER CHASSIS



This under chassis view should act as a wiring guide. The method of component mounting employed should be an aid to neatness and facility of wiring.

input electrolytic to handle the peak voltage would be questionable, and we suggest using one with a somewhat higher rating.

Another possible rectifier for use in this circuit is the 6V4. It is rated for an output of only 90mA., and, to be on the safe side, the output valves should be slightly over-biased to reduce the current drain. Raising the cathode bias resistors to 300 ohms should be sufficient to reduce the current drain to within the rectifier's rating.

USE OF FEEDBACK

Feedback from the output to the input is applied in the now traditional manner. About 15db is used, being a safe enough figure for most of the cheaper output transformers. The feedback resistor specified is for a 15-ohm voice coil. If it is desired to use a speaker with a 2-ohm coil, then the transformer must be purchased to suit and the feedback resistor should be reduced to about 1,800 ohms.

The circuit shows a capacitor in series with the feedback line, as an optional item. If included, it will boost the bass response quite markedly. You may or may not consider it necessary. A larger value will give somewhat less effective boost.

Again, the value quoted is for a 15-ohm circuit. For a 2-ohm circuit, the value would need to be nearer 1 mfd

Remember that the polarity of the feedback must be established by trial and error. If the feedback is positive, it will increase the gain of the amplifier and cause it to oscillate, usually at an audible frequency. To correct this, reverse either the primary or the secondary leads of the output transformer, not both.

A wide selection of speaker and output transformers are suitable for this amplifier, their quality and cost governing the final result.

Among the larger speaker transformers we have tried, the Rola and the MSP types gave acceptable results. The transformers we finally used cost a few shillings more than these, but added a worthwhile margin to the performance. They are the Ferguson types OPM1. There are better and more costly transformers available, but it is doubtful whether their cost could be justified in a simple amplifier such as this.

Balance between the channels is achieved simply by means of a potentiometer in the input circuit. There will be adequate control to achieve equal output from the channels.

Our tests were done with the Acos 73-la turnover cartridge which would be representative of the better quality crystal cartridges. Its output on the average disc was more than sufficient to fully load the amplifier.

HIGH OUTPUT PICKUPS

Pickups with greater output should not present a worry as the volume control is in the input circuit, making it impossible to overload the first stage before the output valve is itself overloaded.

If you find that there is gain to spare, it would be feasible to increase in value the 1-meg. resistors in series with each input channel. This will tend to increase

(Continued on Page 35)

NEW *Releases!*

CLASSIC RADIO TAKE PRIDE IN ANNOUNCING COMPLETE NEW RANGE OF MONAURAL AND STEREOPHONIC EQUIPMENT

Stereophan LIVING SOUND

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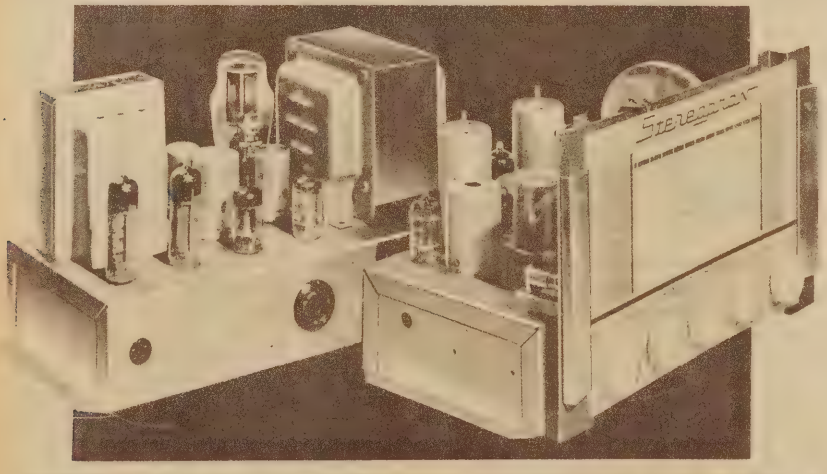

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SPECIFICATIONS ON OPPOSITE PAGE

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- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast rewind in either direction.
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
  No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
- **FINISH**
  Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
  3¾, 7½ and 15 inches per second.
- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
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  Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear.

COMPLETE RECORDER WITH MIKE — 84 GNS. f.o.r.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 71 GNS.

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Dual speaker combination using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive 'magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

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AE21

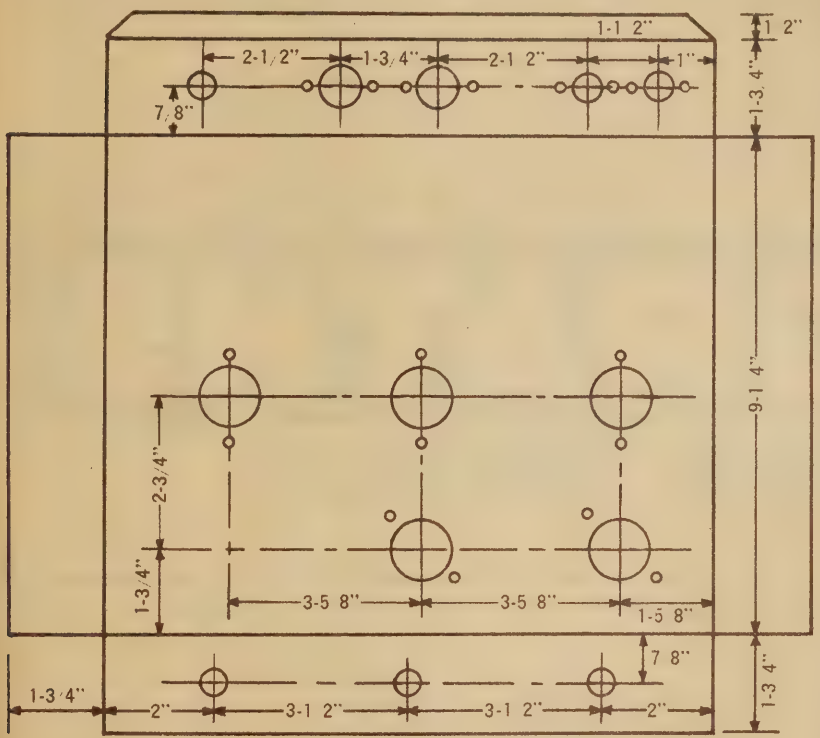
the bass response which may be useful in cases where the nature of the speaker baffling ends to limit bass output. Increasing the bass response in this way would be preferable, where practical, to "doctoring" the feedback.

No doubt many will have speakers on hand which they wish to use. However, if these are to be purchased, we would suggest the cheaper twin-cone 8in or 12in types mounted in a "boffle" or vented type of enclosure.

So much for the electrical side, and now for some constructional details.

We have used a single component strip to mount the minor components, requiring only connecting leads between the strip and the respective valve socket pins. Likewise, with the exception of a few odd components, connections are made between the controls and the respective socket pins.

Looking at the under-chassis photograph the components on the strip, from left to right, are: The first filter electrolytic, the decoupling resistor, the cathode bias resistor and its bypass from the output stage of one channel, then the coupling capacitor and the plate load, followed by the screen dropper and its bypass of the same channel. This is in turn followed by the bias resistor and bypass of the voltage amplifier stage.



A sketch of the suggested chassis showing the essential dimensions. Variations to suit individual components on hand are in order. Suitable chassis materials are 16 gauge aluminium or 18 gauge steel.

The layout is essentially simple and the various components fall into logical sequence. A study of the accompanying photographs should assist those planning to use a different chassis, as well as those adhering to our layout. For the latter, we have included a sketch of the suggested chassis.

You will note that we have used midget potentiometers and that the chassis dimensions make no allowance for the larger types. For those having standard potentiometers on hand, it will be necessary to move the valve lineup toward the rear of the chassis or, if large output transformers are used, to add ½in to the front of the chassis.

WIRING DETAILS

Valve placement is not critical and will be determined by the method of wiring employed. The main requirement is to provide adequate space for the associated wiring and components, as well as keeping in mind their relationship to the controls.

One of the most important points to watch in arranging the major components on the chassis is that the power and output transformers should be arranged with their cores at right angles to each other.

Components of the second channel are next in line and are duplicated, commencing with the output stage bias resistor and bypass and ending with the bias resistor and bypass of the voltage amplifier stage.

With the exception of the dropping resistor in the H.T. line, the decoupling resistor and output stage bias resistors, the resistors used may be half-watt types. The first mentioned should be five watts, one watt and three watts respectively.

The voice coil output is taken to two four-pin sockets on the rear edge of the chassis. Feedback resistors are mounted across the lugs of these sockets.

Having completed your amplifier you will naturally wish to check its performance. Here are a few readings which should act as a guide, a few volts one way or the other being permissible.

Measuring from 6V6 plate to cathode, you should get 250 volts; screen to cathode, 270 volts; total HT measured at the second filter capacitor, 282 volts; output valve bias, 12 volts; total current drain 100 mA.

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Mullard 2 Stereo chassis box in heavily plated dichromate steel. 40/ plus 25 p.c. S.T. Front plate printed with all graduations, 19/6.

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Cat. No.	Long	High	Deep	Price plus 12½ p.c. tax
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MC 7	10	8	7	22/6
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SF 71	11	6½	7¼	32/6
SF 8	13	8	8	39/-
SF 10	18	10	10	50/-

Chassis of 16-gauge Aluminium can be supplied for any of above, all prices plus postage, and slightly higher interstate.

MacKinnon and Nicholls Pty. Ltd., 468 Collins St., Melbourne.

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4F	£2/6/	9-6H	£3/0/6
5C	£2/0/6	9-6L	£3/10/
5F	£2/8/	10-3G	£2/14/6
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Here's your answer, Tom!

One might suggest, this month, that Tom appears to be making light of his subject. However, this remark has nothing to do with levity; it's just that Tom's first two or three questions are about — light!

What is the purpose of the electron multiplier and how does it function?

The electron multiplier, Tom, is a type of photocell in which high gain is obtained by the use of secondary emission.

In cases where the output from a photocell must be greatly amplified before it can be put to use, difficulties arise in the use of valve amplifiers. Where several high gain stages of amplification are used, troubles arise in the form of valve and component noise, microphony, leakage effects, etc.

The result can be a very pronounced masking of the actual signal which tends to become lost against a background of random noise.

Difficulties of this type may be largely overcome by the electron multiplier, in which photo-electric and secondary emission effects are combined in the one envelope to produce an output current several thousand times greater than the photo-electric effect of the input light signal.

The principle of operation of the electron multiplier is shown in the reproduced sketch.

Under the stimulus of the incoming light, shown by the dotted arrow, the photo-electric cathode emits electrons which are attracted by a positively charged anode, designated anode 1 in the diagram.

On striking the anode surface, these primary electrons from the cathode liberate secondary electrons which, by a suitable choice of the anode material, may be made to exceed the primary electrons in number. This effect is known as secondary emission.

The secondary electrons thus released are directed at and attracted by a second anode with a higher positive potential than the first. On striking the second anode the electrons release an even greater number of secondary electrons. This process continues to the final anode.

Theoretically, this form of multiplication can go on indefinitely, but, in practice, repulsion between individual electrons causes a progressive spreading of the electron beam and limits the number of stages that may be used. Heating of the final anode also sets a limit. In normal practice, amplification of about 10,000 may be achieved.

★ ★ ★

What is the difference between the photo-electric effect and photo-conductivity?

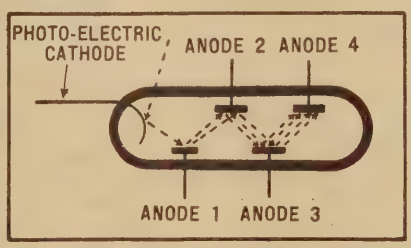
The photo-electric effect, Tom, is the production of an electric current or the emission of electrons by light falling on photo-sensitive materials or surfaces treated with such materials.

Metals of the alkali group exhibit a very strong photo-electric effect when bombarded by light rays, of which the metal caesium is a notable example.

The photocell tube, as we know it, utilises this principle. In it, light rays falling on a photo-sensitive cathode cause electron emission. The electrons are collected by an anode which is at a positive potential. The current flowing in the anode circuit is proportional to the total light flux falling on the cathode and any variations in the light flux cause corresponding variations in the anode current.

Photo-conductivity is the phenomenon exhibited by certain substances, notably the element selenium, in which their electrical resistance varies with a change in the intensity of the light falling on them.

As the intensity of the light falling on a selenium cell increases the resistance of the cell decreases and vice versa. However, it has one disadvantage in that it is sluggish in its response to light variations. The decrease of resistance with a light increase is rapid at first, slowing down considerably at each light change.



The operating principles of the electron multiplier tube.

In the opposite direction the reaction to a sudden change is more sluggish, the resistance of the cell being slower to return to its former value.

Oxidised thallium sulphide is also very sensitive to light changes, particularly in the infra-red region. The cells are made up in evacuated glass envelopes and are almost instantaneous in their reaction to sudden light changes.

Although it is sometimes possible for photo-conductive cells to operate sensitive instruments and relays directly, it is more usual to use them with an amplifier. In such cases, the cell is simply connected in series with a resistance and a voltage source, between the grid (and cathode) circuit of a valve amplifier.

As the resistance of the cell increases or decreases with variations of the light intensity falling on it, the voltage across it varies causing corresponding variations in the voltage across the series resistor. This action, in turn, changes the voltage between the cathode and the grid, thus controlling the plate current in accordance with the light variation falling on the cell.

★ ★ ★

What about the photovaltaic effect?

The photovoltaic effect is a property of certain photocells to develop a voltage when illuminated without requiring any external source of supply. In this respect they have an advantage over the emission and photoconductive type cells, particularly where simplicity is a prime consideration.

Their chief application is in illumination light meters and photographic light meters.

Their principle of operation depends on a combination of two materials. The active material is deposited on a metal plate (copper in a copper-oxide cell and iron in a selenium cell) to form one electrode. The other electrode is a thin, transparent film of metal, which is sprayed on the active material.

When light falls on the transparent electrode, its energy "loosens" electrons in the active material which flow from the active material to the front electrode and through an external circuit back to the active material through the metal plate.

This type of cell may employ various forms of construction, but the action remains the same.

★ ★ ★

Is it desirable for the internal resistance of a rectifier valve to be low?

It is very desirable for the internal resistance of a rectifier valve to be low, Tom, since the path between the cathode and the anode within the valve is part of the direct current circuit. Any voltage drop across it must be subtracted from the voltage available from the supply.

Also, if the valve has a high internal resistance, the voltage drop across it will vary considerably with the current demands of the load. This results in what is termed "poor regulation" and is undesirable.

Reducing the spacing between the anode and the cathode reduces the resistance of the internal path. However, there is a limit to which this can be carried, since there is danger of flashover between the electrodes, particularly when the anode swings negative on each alternate input cycle.

This reverse voltage is referred to as the peak inverse voltage and is seldom less than twice the applied alternating voltage. Designer and users both have to take this into account, with the result that a certain amount of internal resistance with valve rectifiers is inevitable.

As a matter of interest, recently available silicon diode rectifiers have an extremely low internal resistance and require lower input voltages for an equivalent output. However, their peak in-

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verse voltage rating is generally low by comparison and they therefore cannot be regarded as a direct substitute for valve (i.e.,, thermionic) types.

Common practice is to use silicon diodes in voltage doubling circuits, where advantage can be taken of their low resistance and high current rating, without exposing them to excessive peak inverse voltages.

★ ★ ★

I am winding a coil for a small receiver. Does it matter what wire I use provided I put on the right number of turns?

Yes, Tom, it does, and for at least two reasons.

The number of turns is vital because, along with the diameter, it determines the general order of the coil's inductance and therefore the range over which it will tune, when associated with a particular variable capacitor.

However, the inductance is influenced by other factors.

If the coil is wound with a much finer gauge of wire than intended, the turns being close wound, the coil will be much shorter than intended and have what is called a different "shape factor."

Conversely, the use of thick wire, or wire with thicker insulation, will make the coil longer. This may be inconvenient in itself but, in any case, it will again modify the shape factor. Some change in the total number of turns may have to be made to maintain the correct inductance and the correct tuning range.

A second major consideration is that the gauge of wire used influences the "Q" factor of the coil. There is a mathematical explanation for "Q" but, in a general way, it can be regarded as the factor of efficiency.

Again speaking generally, coils wound with heavy gauges of wire are more efficient than those wound with thin wire but, of course, they are naturally more bulky. Thus practical coils have to be a compromise between these two main factors.

Naturally enough, the reverse is true and coils wound with wire much thinner than intended will not work as well as they should and the ultimate performance of the set will suffer.

So, Tom, it is very wise to follow specifications as closely as you can and save yourself possible headaches. At the same time, there is no point in making a fetish of wire gauge.

If you have something that is very close to what is called for, use it by all means. A gauge or so either way, provided it can be accommodated on the former, should not make much difference to a small set—and we take it that you are interested in small sets.

★ ★ ★

I noticed that some modern films are released with magnetic soundtracks. Is this the same idea as in tape recorders and does it mean that this kind of soundtrack is better than the optical?

The idea behind magnetic soundtracks for films is much the same as for tape recorders. In the case of films, the magnetic material is "striped" on to the same film which carries the picture. It can go in the area which formerly carried the optical track, while it is also possible to put a useful magnetic stripe along the edge of the film outside the sprocket holes.

Actually, some of the films using magnetic tracks are not on standard 35mm stock at all, but are on 70mm stock, which allows more room for both picture and soundtracks.

Speaking generally, it is possible to get better audio quality from a magnetic track than by optical means, while, by making the tracks narrower, it is also easier to obtain multi-channel or, shall we say, stereoscopic sound.

However, the use of magnetic sound tracks does require the provision of special heads on the projection equipment, which poses obvious problems for small theatres. Also the magnetic tracks are more prone to damage by exposure to magnetic fields, so that more care is necessary in their handling and storage.

★ ★ ★

What is the difference between a spark and an arc?

Although the two terms are often used synonymously, Tom, there is a different shade of meaning.

When two conductors with a sufficient difference of potential between them are brought close together, the gas in the path between them will ionise and a spark which tends to equalise the charges occurs.

As an example, a flash of lightning is a very large spark, the two conductors in this case being two clouds or a cloud and earth. The electric strain set up in the gas between the conductors causes it to ionise and conduct. The rush of current heats up the gas and causes it to light up with brilliance.

An arc is different in that it forms when a conductor carrying current is broken. The current persists in spite of the break in the metallic circuit and is carried over the gap by ionised gas.

Thus it may be said that a spark occurs between conductors initially having a large potential difference while an arc occurs at a break in a circuit which is carrying a large current. In this sense, therefore, sparking is associated with voltage and arcing with current.

★ ★ ★

What is a hot-wire detector?

A hot-wire detector, Tom, is an obsolete type of detector utilising the fact that the passage of current through a fine wire raises its temperature, which in turn alters its resistance.

The circuit arrangement for this type of detector is in the form of a bridge network which is normally balanced, so that no current flows in the null indicator.

The radio frequency signals to be detected pass through the arm of the bridge containing the fine wire, the temperature of which increases and causes the resistance to increase. This throws the bridge out of balance and current flows through the indicator.

Provided the change in resistance is small, the current in the indicator is directly proportional to the change of resistance. Since the current flowing in the indicator may be larger than the R.F. current which causes it to flow, some amplification also takes place.

The obvious limitation of such a device is that the current can only change at the rate at which the wire can alter its temperature. Thus the frequency response is limited by thermal characteristics.

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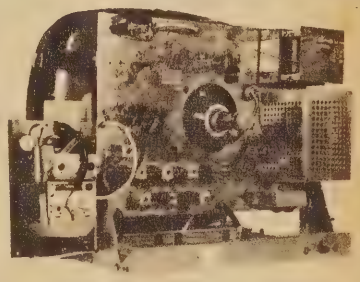

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The six volt version of our tachometer is shown here with a commercial 250 deg, 4in square meter. Although more expensive than the 90 deg meter, this type may be more suitable in many applications where the higher cost is justified. It is available in a variety of sizes.

A Tachometer For 6-Volt Operation

Last month's description of a tachometer no doubt whetted the appetite of a great many sports car and speed boat enthusiasts. But many were doubtless disappointed to find that it was suitable only for 12-volt systems. For them, this article is the answer—a 6-volt transistor tachometer virtually as good as the 12-volt version.

by Philip Watson

THERE were several problems to be overcome in converting this circuit for six-volt operation and, in some respects, we have not been able to adhere to the close tolerances which were possible with the 12-volt unit. Nevertheless it is possible to make a perfectly practical instrument, having quite adequate accuracy for all the usual applications.

However, before discussing the final design, it may be profitable to consider some of the approaches we considered and the problems we encountered.

The first one concerns voltage regulation. This is a good deal more difficult at six volts, particularly if we wish to keep within the 10 per cent tolerance range of the zener diodes. The 5 per cent types would make things easier, but the higher cost (about double) may be an objection in many cases.

SUITABLE DIODE

In selecting such a diode we have to reconcile two conflicting requirements. One of these is to preserve as big a margin as possible between the supply voltage and the regulated voltage, since the larger this margin the better the regulation. The other is to provide regulated voltage which is adequate for the equipment.

The problem thus becomes one of determining by what order we can reduce the operating voltage of the unit and still retain adequate overall sensitivity. More specifically, we have to select a voltage which comes within the range of available zener diodes. (As we shall see later, there are other factors which tend to complicate this problem.)

The most likely type in this category appeared to be the Z2A47, with a nominal operating voltage of 4.7 volts and a tolerance of 4.2 to 5.2 volts. If we could consider the 5 per cent types, the Z2A43 (4.3 volts nominal, tolerance 4.05 to 4.55) would seem a logical choice.

While retaining a 1 mA meter movement, we established that it was possible to make a unit which would work on a regulated supply as low as four volts, but this appeared to be the lower limit. At lower voltages we encounter difficulty in providing full-scale meter deflection at 166 cps, representing a four-cylinder engine at 5000 r.p.m.

To achieve adequate sensitivity at this lower voltage, we had to investigate the extent to which this could be done by increasing the differentiating capacitor. It may be remembered that we suggested this in conjunction with last month's circuit, when faced with a minor sensitivity problem.

A larger differentiating capacitor increases sensitivity by simply increasing the width of the spikes we feed to the meter. Since they now contain more energy, a given number of spikes will produce a greater meter deflection.

LIMIT

However, a point eventually is reached where we make the spikes so broad that, at the higher freqeuncies, they commence to overlap. When this happens, the linearity of the meter readings will be seriously affected. Thus there is a limit to the increase we can obtain by this means.

Assuming a minimum regulated supply of four volts, it appears that we may need up to 2 mfd in order to provide full-scale deflection on a 1 mA meter at an input frequency of 166 cps. This value of capacitance is about the maximum permissible at this frequency without risk of overlap.

At higher frequencies the maximum permissible capacitance is less, but the requirement also is less. Thus, under the same conditions, a value of 1.5 mfd should be adequate at 250 cps (six cylinders at 5,000 r.p.m.) and 1 mfd at 333 cps (eight cylinders at 5,000 r.p.m.).

In brief, the differentiating capacitor should be made no larger than is necessary for adequate sensitivity. All that is required is full-scale deflection at the selected top frequency, with a small margin for adjustment of the calibration control. If the latter needs to be backed off substantially, then the capacitor may profitably be reduced.

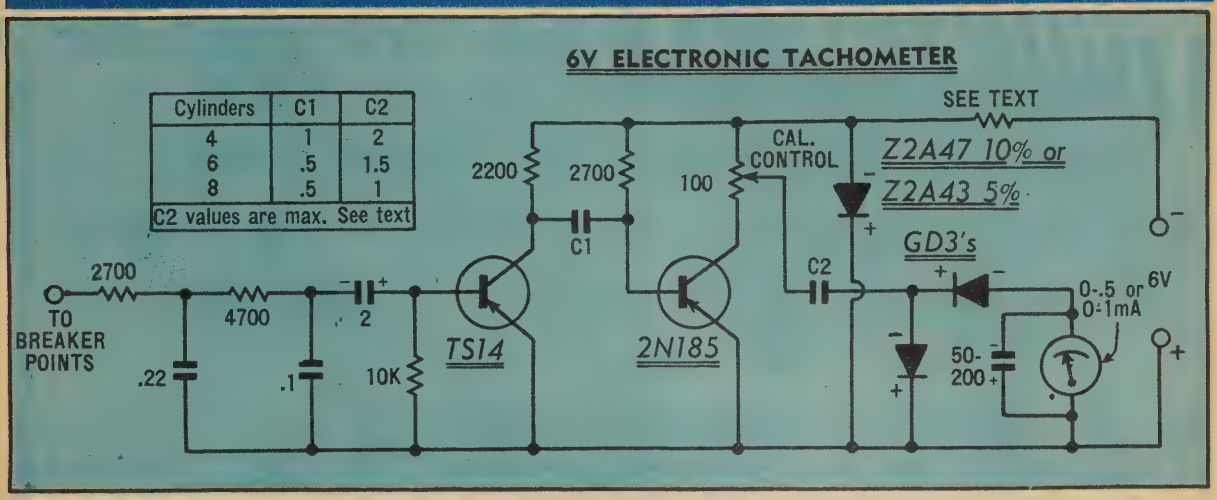
LOWER STILL?

Having thus achieved adequate sensitivity at a voltage suitable for the Z2A47 it was natural that we should ask whether we could move down the scale one step further. The next diode in the 10 per cent range is the Z2A39, with a nominal voltage of 3.9 and a tolerance of 3.5 to 4.4. Thus the unit would have to be capable of operating with a regulated supply as low as 3.5 volts.

It seemed logical to expect that such a step would give some improvement in regulation, due to the greater margin between the regulated voltage and the supply voltage, and would be worthwhile if it could be achieved without too much difficulty.

Since we had increased the differentiating capacitor to the maximum permissible value, the only remaining possibility seemed to be the use of a more sensitive meter, such as a .5 mA type.

FEW CIRCUIT CHANGES FOR SIX-VOLT VERSION



The basic circuit remains essentially the same for six volt operation, the main changes being to the voltage regulating circuit and the differentiating capacitor, the latter to provide adequate sensitivity. A 1mA meter can be used if available, but a .5mA type would make some component values less critical.

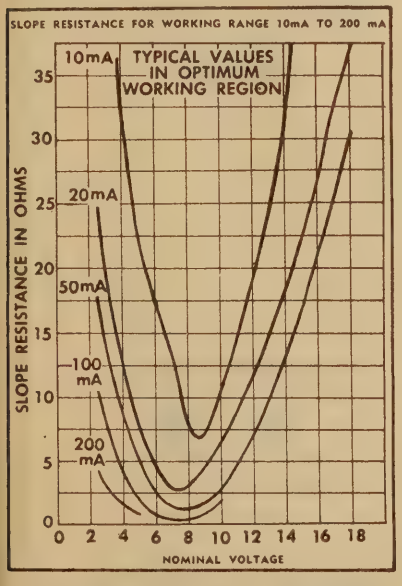
Accordingly we set up a temporary 3.5 volt supply and checked the sensitivity of the unit on the basis of a .5 mA full-scale deflection.

The set-up looked quite promising. We were able to achieve adequate sensitivity using quite moderate values of differentiating capacitance, and we felt that the specification of a .5 mA meter, while a restriction in regard to meters likely to be on hand, was not a serious objection.

All that remained was to work out details of the Z2A39 regulator circuit and check performance. Armed with the necessary diode and a variable resistor, we set up what appeared to be optimum operating conditions and proceeded to check performance against that already established for the Z2A47.

Unfortunately, results were rather disappointing. Regulation appeared to be no better than before and, in some circumstances, even marginally worse. We tried varying the operating conditions within permissible limits to make sure they were as near optimum as could be, but without any significant improvement. For some reason, and in spite of the improved voltage margin, this arrangement appeared to be no better than the previous one.

The cause of this apparent contradiction was eventually traced to the "slope resistance" characteristic of the respective diodes. "Slope resistance" is a convenient means of expressing the sharpness and effectiveness of the zener characteristic; something which is not necessarily the same for practical diodes having different operating voltages.


SLOPE RESISTANCE FOR WORKING RANGE 10mA TO 200 mA
SLOPE RESISTANCE IN OHMS
NOMINAL VOLTAGE
TYPICAL VALUES IN OPTIMUM WORKING REGION
10mA
20mA
50mA
100 mA
200 mA
0 2 4 6 8 10 12 14 16 18
0 5 10 15 20 25 30 35

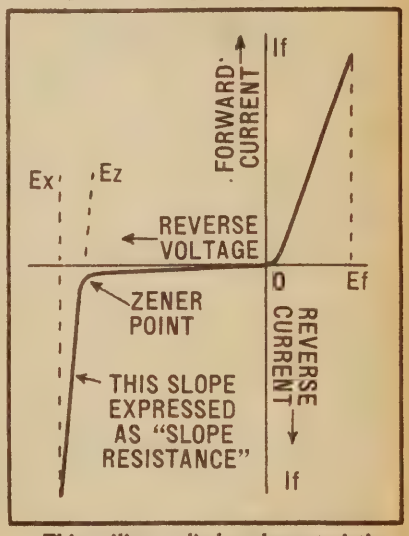
This graph from STC data shows how the slope resistance varies with voltage and current. The higher slope resistance at lower operating voltages is a limiting factor in voltage regulation.

ZENER CURVE

A better understanding of this characteristic may be gained if we study a typical zener curve. The portion which interests us is that to the left of the zener or turnover point, and which is usually shown in explanatory diagrams as nearly vertical. More particularly, we are concerned with the actual angle produced by practical diodes, or the "slope" of the curve.

It is fairly obvious that the sharper the "knee" at the zener point and the more nearly vertical the slope thereafter, the better the diode as a control device, since a small change in voltage will produce a large change in current. However, since we are plotting voltage against current, this slope is only another way of expressing resistance. A near-vertical slope represents a very low resistance, and a near-horizontal one a very high resistance.

Thus, we require our zener diode to have the lowest possible "slope resistance" beyond the zener point, and this figure may be taken as a measure of "goodness" of a particular unit. Unfortunately, the Z2A39 has a higher value of slope resistance than the Z2A47, and this appears to be enough to offset the advantage we would otherwise gain from the improved voltage margin.



This silicon diode characteristic shows the zener point and the sloped portion which is expressed as slope resistance. The lower this value the better.

As a matter of interest, we are publishing a set of curves showing how the slope resistance varies over the range of operating voltages and currents. It will be seen that, at all operating voltages, the resistance is lowest at high currents, while there is a dip in the curves around seven to eight volts. This appears to be a natural characteristic of diodes so far available and means that, as far as we are concerned, conditions are less favourable as we try to use lower voltage types.

The next point we had to consider was the voltage developed across the distributor points for application to the TS14. This is roughly a rectangular wave and, in the 12-volt system, will

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have a peak to peak voltage of 12. However, in a 6-volt system, this input voltage also is reduced to 6, and we have to consider whether this is sufficient to drive the TS14 into the limiting condition.

This condition is essential, since the system becomes amplitude conscious if this does not occur, making the readings meaningless. For those who may be forced to conduct their early experiments using a sine wave audio generator, it should be realised that six volts peak to peak is only about 2.1 volts RMS. The system must be capable of limiting on this voltage at least, with some margin desirable for safety.

INPUT RESISTOR

In our original circuit of last month, the input was barely sufficient for a 6-volt system, though more than adequate for the 12-volt system. In considering this, we remembered that we had reduced the TS14 emitter-base resistor from the 10K originally suggested to 1,000 ohms. This seemed to offer a small advantage and, since it presented no complications, we retained it.

However, it does reduce the input to the TS14 and, since this was so important in the case of the 6-volt system, we had no hesitation in reverting to the original value. Using it, we had no trouble in providing adequate limiting with an input of only 4 volts peak to peak—an adequate safety margin in any circumstances.

The final result of all this investigation is the circuit shown here, designed around the Z2A47. It should have enough sensitivity for the lowest frequency likely to be encountered, and a regulation which, while not as good as that obtained with the 12-volt circuit, should be adequate in practice.

The main difference between this and the 12-volt version is that some of the component values are rather more critical and will have to be selected on a trial-and-error basis. The main considerations covering the differentiating capacitor already have been discussed, the point to remember being that the values shown in the circuit are maximum, and it may be possible to use smaller values in some cases, with advantage.

NEW METER

(We would, in any case suggest using a .5 mA meter if a new meter has to be purchased anyway, since the cost is not likely to be any greater. The higher sensitivity will allow smaller differentiating capacitors to be used and make this component less critical in terms of sensitivity versus linearity.)

The next point concerns the selection of a suitable series resistor for the particular diode. This is best determined experimentally, using a variable resistor and a milliamp meter, substituting a fixed resistor when the correct value is determined. Take care to see that the variable resistor is set initially for maximum resistance, otherwise the diode may be destroyed.

The best approach appears to be that of nominating the maximum voltage likely to be encountered by the unit, then selecting a series resistor which will allow maximum current to flow under these conditions, within the ratings of the diode. At the minimum voltage, the current should be not less than 20 mA, but may be higher with advantage.

Most car electrical systems are designed to develop about 7.5 volts across a battery under conditions of maximum charge rate, i.e., assuming a flat battery. Eight volts would be unusually high, and normally would suggest incorrect adjustment of the voltage regulator. It seems reasonable to take the nominal voltage of the battery as the minimum figure.

TEST VOLTAGE

A convenient way of providing 7.5 volts for test purposes is to connect a 1.5 volt dry cell in series with the six volt accumulator. However, make sure the cell is in good condition and does, in fact, deliver its rated voltage under load. It is best to monitor the total voltage with a meter.

In checking the diode current, make sure that the meter is reading the current through the diode only. Make the measurement between the positive end of the diode and the positive supply line.

Allowing for temperature derating, the maximum permissible current through the Z2A47 is 140 mA, and through the Z2A43 165 mA. Adjust the variable resistor to give these figures, then check that the minimum current (at six volts) is above 20 mA. In most casse, it will be roughly one-third the maximum current.

In our case a resistance of 15 ohms proved correct for the Z2A47 and we suggest a 30 ohm pot as a variable resistor for the initial experiment. The fixed resistor may need to be made up from two higher values in parallel and the current should be checked again when this is fitted to allow for normal tolerances.

(Incidentally, the operating conditions quoted for the Z2A82 in last month's article were incorrect. These were given as 170 mA maximum at 16 volts and 40 mA minimum. The correct maximum value after temperature derating should be limited to 80 mA for this type, and the series resistor should be selected accordingly.)

Varying the supply voltage between the six and 7.5 volt taps while the unit is working will allow the effect on accuracy to be noted. In our case, this shift produced a change at full scale of 4 per cent.

In considering this error, it should be borne in mind that a good electrical system normally would operate within much narrower limits than these. Unless a battery is faulty (in which case it should be replaced, anyway), it is most unlikely that it will ever require the maximum charge rate and a voltage of 7.5.

Only if a battery had become almost completely discharged, due to some unforeseen accident, would such a situation exist. In addition, it would be a purely temporary one, the voltage being reduced as the battery commenced to charge.

For these reasons, we feel that the regulation, while not as good as that obtained from the 12-volt system, should be perfectly satisfactory in practice.

From a constructional point of view, there is little we can add to our description of last month. The only major difference will be the need to accommodate the larger differentiating capacitor. This probably will have to be made from two units and may be mounted above and below the board as we suggested last month, or side by side with one unit above the GD3 rectifiers.

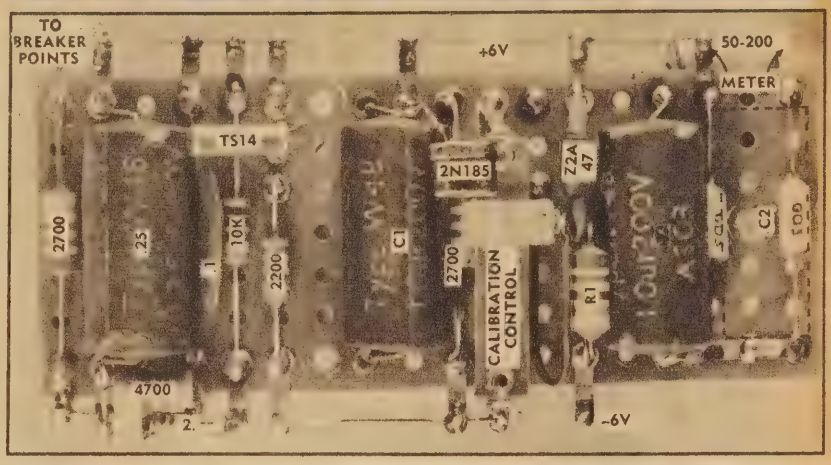
ALTERNATIVE APPROACH

Another approach which may appeal to some constructors is to build the entire circuit in the back of a meter case, and this makes a very convenient unit if a meter can be found with enough space to house all the pieces.

Since the layout is not particularly critical, the components may be distributed in almost any manner dictated by the available space. Nevertheless, accommodating all the necessary parts in a standard 90 degree meter might be difficult, and would certainly call for a lot of ingenuity.

We heard of one enthusiast who "scored" a very suitable meter from a piece of disposals equipment. Not only did it have a very deep barrel in which the components could be accommodated, but it used a 270-degree meter movement as well. All we have been able to learn about it so far is that it came from a radio altimeter, type 1D-14B/APN-1. However, we pass this information on for what it's worth.

CODED PHOTO SHOWS ASSEMBLY



No major changes in layout are involved in converting to six volts, but the need to accommodate more differentiating capacitance may call for some minor changes. One suggestion is shown here as a dotted outline.

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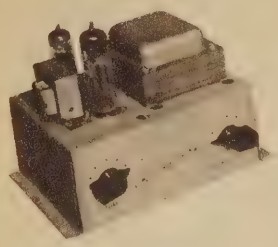

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NEW BOOKS

HI-FI MADE EASY, by Norman H. Crowhurst. Soft cover, 224 pages, published by the Gernsback Library (No. 90). Contains a profusion of line sketches and diagrams.

Intended for the beginner in audio and Hi-Fi, this book explains in a clear-cut, easy-to-read manner the fundamentals of sound, recording on both tape and disc, amplifiers, and speaker systems. It also contains a chapter on stereo.

The book deals with these subjects in a way in which humour is introduced to gain the readers' confidence, but also provides a source of analogies which help to explain some rather technical ideas. The analogies used do not in the main give wrong impressions, but appear to have been carefully introduced.

Components of the recording and reproducing process are not dealt with together but are discussed separately and the problems associated with each one discussed in some detail.

Three complete chapters are devoted to sound, hearing, and distortion, providing an introduction to the whole idea of hi-fi and high quality sound. A single chapter gives a light background of electronics, sufficient for the non-technical music lover.

The rest of the book gives quite a fair description of speakers, microphones, pick-ups, and records. The whole book is written in such an easily followed style that even the most non-technical of readers should have no difficulty in following it.

Our copy was from the publishers but copies should be available locally in due course.—(J.R.).

SHORT WAVE RECEIVERS FOR THE BEGINNER. Published by Data Publications Ltd. 5¼in x 8in, soft cover, 72 pages. Contains photographs, circuits, wiring diagrams, and chassis blueprints.

Designed as an introduction to short wave receiver construction and use, this book would be handy for the novice. The opening chapters deal with fundamentals, amateur bands, Q.S.L.s, and listening procedure.

Full details for the construction of a one-valve regenerative set are then given, after a brief note on soldering practice. An audio stage is also given as an addition to this set. A simple two-valve all-wave receiver is then described, followed by another, smaller, two valver.

A progressive type of receiver is then discussed, which grows into a three valve set having an RF stage. Two types of power supply are included also, as the sets are treated without a power supply of their own. A battery eliminator for existing battery sets is also described.

As this book is intended for the beginner, it contains wiring and construction hints, as well as resistor colour codes.

Our copy came direct from the publishers (Data Publications Ltd., 57 Maida Vale, London, W9), but the book will no doubt be available locally in due course.—(J.R.).

MONTHLY NEWSLETTER

This month we have the most important news ever released in this column. Due to the support you have given us over the past 18 months we have decided to open a new showroom large enough to take the most comprehensive display of imported radiograms, hi-fi and stereo equipment, TV receivers and accessories that have ever before been seen in Australia.

Our new showroom, as from this date, is situated in the heart of the Camberwell Junction, the number one Melbourne shopping centre outside the city area. We chose this site for your convenience, mainly because it is easily accessible and, secondly, we have no parking problems as we have our own private parking area.

As well as expanding in the retail activity we now have a full wholesale department to enable all trade purchasers to buy direct from us in the suburbs, rather than travel all the way to the city to their normal suppliers. This department covers component parts and spares, audio equipment, public address components and hardware. Our many friends realise, of course, that all equipment sold by this company will always be serviced by us in future years.

We have also included a large new record department to cater for all needs in recorded music on both disc and tape.

A new holding company has been formed to enable all this to operate and our new title is "United Electronics (A/asia.) Pty. Ltd." We are now considering the appointment of agents in other States for many lines of imported equipment for which we are national distributors.

Continuing from our world review of preceding months, we would like to take the opportunity here of mentioning some of the highlights of my visit to England. In particular to say thank you to Mr Smith and Mr Bradford of "Grampian," with whom I spent some enjoyable time, and Mr Hawkins of "Leak" and hope next month to describe a fascinating tour of that company. Perhaps Australian readers will be happy to know that this magazine is read overseas and that this acknowledgement will be received by those concerned. These friendships, and many others which I made in England, were brought about through the kind introduction of Simon Gray Pty. Ltd., the Australian distributors of much of our fine audio equipment.

The amount of developmental work going on in all plants I inspected is amazing, showing that the quality and advancement with which we are familiar at the moment is ensured for years to come. It seemed to me that all the plants with which I came in contact had their own pleasant surroundings and gardens, a feature not shared with any other industry that I noticed — probably a symbol of prosperity. Most of these plants are self-sufficient, making all their components in their entirety, on attractive garden factory estates.

Our readers may not realise that Grampian, along with their normal domestic audio amplifiers, with which we are familiar, make a vast range of audio equipment covering the public address system range, powerful industrial amplifiers for vibration tables, speakers and microphones, along with many other fields.

The Decca stereophonic pickup has really proved a "wow" on the Australian market, as you will realise, and, considering performance versus price, is an ideal choice for any stereo system. Although the output is low in comparison to some other magnetic types the third coil in the head for monaural recordings is a great advantage.

Next month, in addition to describing more fully advances in English equipment, we shall bring you full details of our magnificent range of products and hope to see all our old friends visit us at our new premises in Camberwell.

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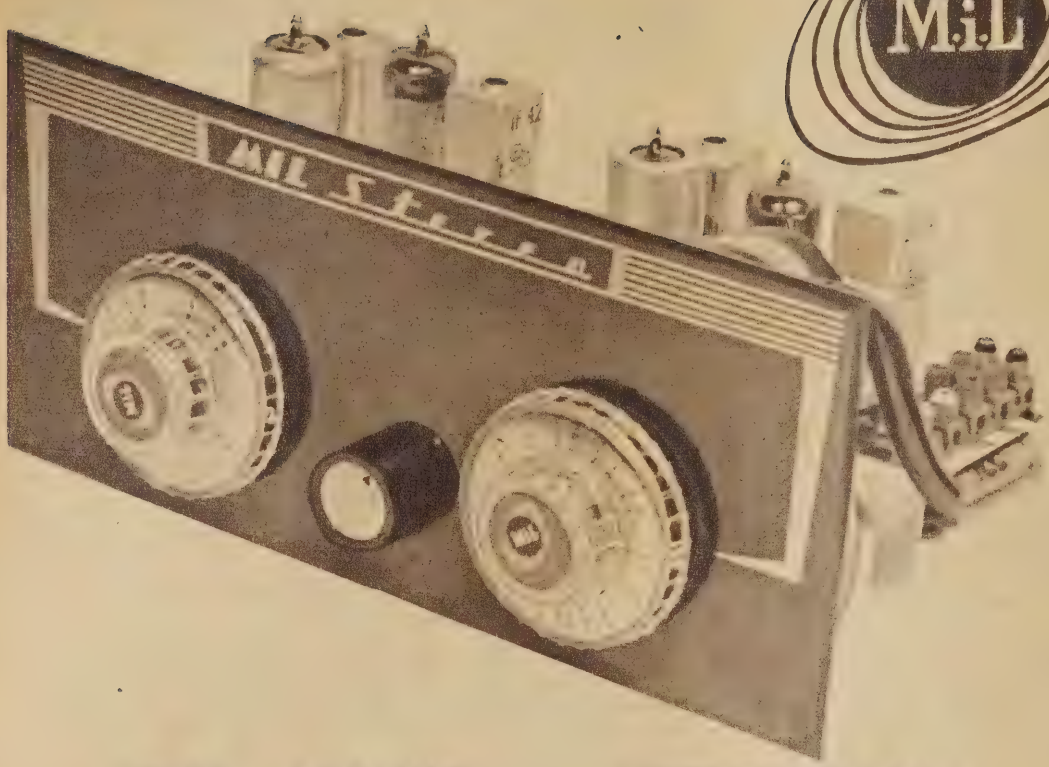

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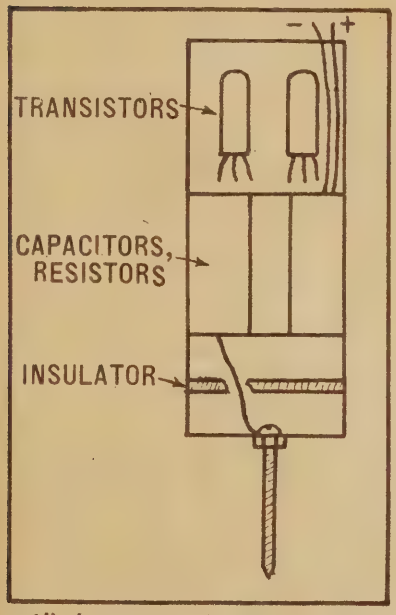
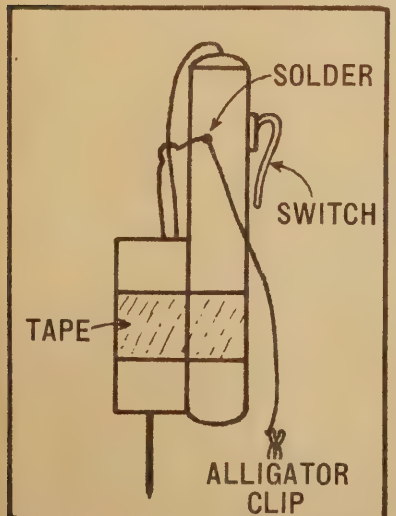
TRANSISTOR MULTIVIBRATOR, SIGNAL-INJECTOR

For the following details of a multivibrator cum signal-injector, we are indebted to Mr J. B. Hargreaves of Newman Park, Mount Morgan, Qld. Concerning the unit, Mr Hargreaves writes as follows:—



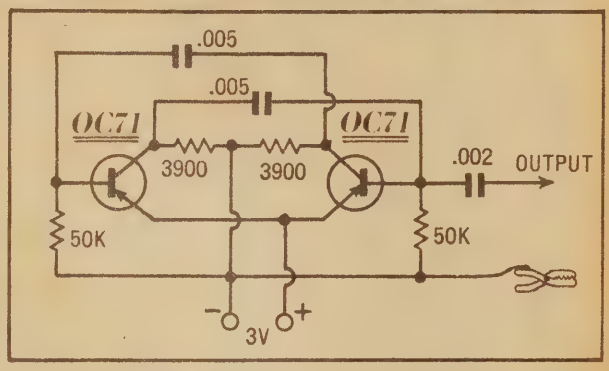
All the components necessary can be mounted inside a pill box, with a probe to inject signals into the circuit under test.



To complete the signal injector, our contributor suggests taping the actual multivibrator to a fountain pen torch case.

BELOW is described a transistorised multivibrator which may be of use for your "A Reader Built It" column.

The circuit is similar to the usual twin-triode multivibrator.



Suggested circuit for the multivibrator.

Voltage requirements are 3 volts and this was provided by using a miniature fountain-pen torch which contains 2 No. 915 Eveready batteries. The current requirements are 0.8mA.

A plug was arranged to take the place of the bulb in the torch and the switch on the torch was utilised.

Miniature capacitors were not available so ordinary 400-volt paper ones were used.

In use as a noise generator the output was usable up to 5 Mc/s. The fundamental frequency is about 1500 c/s but this can be reduced by using larger coupling capacitors. The amplitude of the output is about 1 volt.

The transistors, resistors and capacitors were packed into a plastic container, 1in diameter by 2¼in long (which had previously contained Ford Pills).

Output is taken out of the container by joining the pigtail from the .002uF condenser to the head of a 2in x ⅛in brass bolt which passes through the bottom of the container.

The bolt is sharpened to a point to act as a prod.

The plastic container is taped to the side of the fountain-pen torch with adhesive plastic tape.

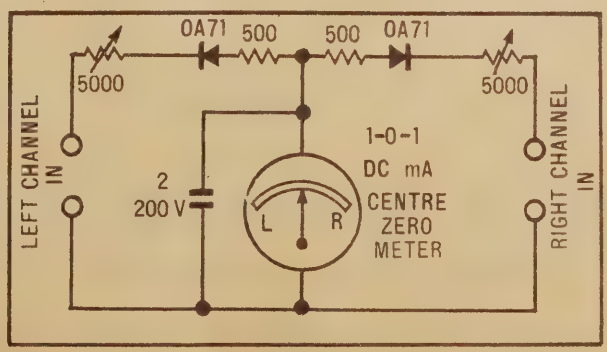
A STEREO BALANCE INDICATOR

THE following idea for a stereo balance indicator comes from Mr R. J. Anderson of The Entrance, N.S.W.

A moving coil centre zero meter is fed through two rectifiers connected in opposition, one to each channel of the stereo system. Suitable multipliers and isolating resistors are provided to suit the sensitivity of the meter movement.

The capacitor across the movement is intended to reduce the swing of the pointer on peaks of output from one channel.

The multipliers are in the form of preset potentiometers for the purpose of calibration. The instrument was connected to the low impedance output from the amplifiers, to eliminate the possibility of unequal gain in each.



When the voltage from each amplifier is the same, the voltage outputs of the rectifiers cancel and the meter remains at centre zero. If the left channel is consistently lower in output, the pointer moves to the left showing that, to restore balance, the output of the left channel must be raised, or the right channel lowered.

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PF299	240	285-0-285	40	6.3V-2A, 6.3V-tapped 5V-2A
PF300	240	325-0-325	40	6.3V-2A, 5V-2A
PF201	240	225-0-225	50	6.3V-2A
PF1459	230, 240, 250	250-0-250	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF151	230, 240	285-0-285	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF1388	230, 240	300-0-300	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF166	230, 240	325-0-325	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF165	230, 240	385-0-385	60	6.3V-2AC.T., 5V-2A
PF1460	230, 240, 250	250-0-250	80	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF1428	230, 240, 250	250-0-250	80	6.3V-2AC.T., 6.3V-0.6A
PF170	230, 240	285-0-285	80	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF1073	230, 240	300-0-300	80	6.3V-2AC.T., 6.3V-1A
PF169	230, 240	325-0-325	80	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF168	230, 240	385-0-385	80	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF1509	200, 230, 240	140 *	100	6.3V-2AC.T., 6.3V-2A
PF130	230, 240	285-0-285	100	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF164	230, 240	325-0-325	100	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF160	230, 240	385-0-385	100	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF1072	230, 240	300-0-300	120	6.3V-4AC.T., 6.3V-tapped 5V-2A
PF152	230, 240	285-0-285	125	6.3V-3AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF163	230, 240	325-0-325	125	6.3V-2.5AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF181	230, 240	385-0-385	125	6.3V-3AC.T., 6.3V-3A, 5V-2A
PF1508	230, 240, 250	250-0-250	150	6.3V-4AC.T., 6.3V-tapped 5V-2A
PF174	230, 240	285-0-285	150	6.3V-3AC.T., 6.3V-3A, 6.3V-tapped 5V-3A
PF142	230, 240	325-0-325	150	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-3A
PF175	230, 240	385-0-385	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF173	230, 240	425-0-425	175	6.3V-3AC.T., 6.3V-2A, 5V-3A
PF1335	230, 240	305-0-305	180	6.3V-4AC.T., 6.3V-4A, 5V-3A
PF1067	230, 240	400-0-400	180	6.3V-2.5AC.T., 6.3V-4AC.T., 5V-3A
PF1412	230, 240	300-0-300	200	6.3V-3.5AC.T., 6.3V-3A, 5V-3A
PF172	200, 230, 240	500-0-500	200	6.3V-4AC.T., 6.3V-3A, 5V-3A
PF814	200, 230, 240	1000-0-1000	200	5.5V-0.3A
		or		
		750-0-750	250	
		or		
		500-0-500	300	
PF179	200, 230, 240	475-0-475	225	6.3V-4AC.T., 6.3V-2A, 5V-3A
PF171	200, 230, 240	385-0-385	250	6.3V-4AC.T., 6.3V-3A, 5V-3A
PF107	230, 240	585-0-585	250	6.3V-3A, 6.3V-3A, 5V-3A
PF1193	200, 220, 240	295-0-295	275	6.3V-9A, 6.3V-tapped 5V-3A
PF1193V	200, 220, 240	295-0-295	275	6.3V-9A, 6.3V-tapped 5V-3A
PF1448	230, 240, 250	115*	300	12.6V C.T.-5A

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FROM THE SERVICEMAN WHO TELLS

Have you, as a TV serviceman, ever wondered how your opposite number in other countries copes with the problems he encounters? Or whether those problems are similar to your own; or harder or easier for one reason or another? While no one report can give anything like a complete picture, one I came across recently contained some very interesting facts.

IT was, in fact, passed on to me by the Technical Editor, and is from the Sylvania News, published by the Sylvania Company in the U.S.A. It deals with the tabulated results of a questionnaire distributed to a large group of TV servicemen in an effort to build up a picture of TV performance throughout the country.

Although we have no UHF service in this country at present, and probably not for many years to come, I feel that the information presented is extremely interesting, both as a means of comparison with our own VHF system, and as an indication of what might be expected from a UHF system.

The following is the relevant portion of the report, which I have condensed somewhat without, I hope, sacrificing any vital information.

SERVICE QUESTIONNAIRE

"Late in 1957, the Television Allocations Study Organisation (TASO) sent approximately 9,000 questionnaires to television servicemen throughout the United States to probe the problems involved in installing and maintaining antennas, transmission lines, the receiver itself, and allied accessories on both VHF and UHF. TASO sought to tap the vast knowledge and experience of the servicemen on all phases of television reception

"TASO was established by request of the Federal Communications Commission for collecting and examining those factors which should be applied to the allocations of television channels. Engineers, numbering 1,271, from 139 companies (nine from Sylvania), worked for two years in the preparation of the report.

"Space does not permit the printing of all the questions asked; however, a brief description will now be given.

"The questions were in six sections:

A. General Information—Name and address of the organisation making the report, the area served, number of service calls, number of antennas installed and a list of the stations received.

B. Receiving Antennas—Kinds of VHF and UHF, height and lead-in information.

C. Receivers—Service problems with various types of receivers on VHF and UHF.

D. Multipath Problems—VHF compared with UHF.

E. Interference—Kinds of and comparison of VHF and UHF.

F. Colour Reception—Kinds of and comparison of VHF and UHF.

VARIED WIDELY

"When finally assembled, the data varied in usefulness and importance. Some was obviously of immediate importance, while some will find use later.

"In the report a most interesting and important table was computed. This is included here as Table 1.

"For this table the distance to all stations reported as excellent were averaged for each of the channel groups shown. Likewise for good, fair and poor.

"Table 1 then is a tabulation of the average distance of an excellent, good, fair and poor picture for each channel group.

"On examination of the table, a curious oddity is evident in the channel group 14-40. The good and fair figures appear interchanged. However, because of the low number of UHF reports, the reversal is one of those statistical events which statisticians can show to be a chance event and has no significance. In short, a few more returns would possibly have altered the data somewhat.

"The serviceman can get a rough idea from Table 1 of how well a new station coming on the air in a neighbouring town will be received. The answer is found by knowing the distance to the station and thus using Table 1 in reverse.

"For example assume a station on channel 10 and a distance of 40 miles. Consulting the Table, one may safely conclude the signals will be from good to fair. It goes without saying that mountain ranges may cause weaker reception than that indicated by Table 1 because of shading effects.

"Another piece of very useful information came in answer to the question what type of outdoor antenna have you found most acceptable for reception in weak and strong VHF and UHF signal areas?

"The computed percentages are tabulated in Table 2.

"From Table 2 we learn that 60 per cent of the servicemen selected Yagis in a weak VHF area while 35 per cent used corner reflectors in a weak UHF area.

"It was also learned that for transmission line 82-94 per cent of the servicemen installed flat twin lead for VHF reception while 83-87 per cent used tubular twin lead for UHF. Sixty per cent of those in combined VHF and UHF areas installed separate lead-ins for reception of VHF and UHF while 40 per cent used the same lead-in for both.

MAXIMUM SIGNAL

"When installing VHF antennas, 53 per cent of the servicemen explored for maximum signal while 81 per cent explored for maximum signal when installing UHF antennas.

"On the subject of ghosts, it was reported that 12 per cent of the VHF sets suffered from ghosts, while 19 per cent of the UHF sets had this trouble. Asked on which sets ghosts were more objectionable, 321 reporters said VHF by 69 per cent, UHF by 18 per cent and both VHF and UHF by 13 per cent.

"A tabulation of the reported interference sources at VHF and UHF is found in Table 3. Here one learns from the reported data the kinds of interference most troublesome and the relative effects of VHF, UHF or both.

Channel Group	(Mc)	Excellent	Good	Fair	Poor	Average Transmitter Power
2-6	(55-83)	22	37	67	76	88 Kw
7-13	(175-211)	22	31	55	71	240 Kw
14-40	(471-627)	15	18	16	27	350 Kw
41-83	(633-885)	11	13	15	22	330 Kw

Table 1. This shows the average distance in miles at which the various grades of reception were observed. Channels 2 to 13 approximate our own VHF system, those 14 to 83 being the UHF channels. Note the short range of the highest group.

Percentage of Aerial Types Most Acceptable

	Corner Reflector	Conicals (Fans)	Dipoles	Yagis	Bow Ties
Weak VHF	—	25	10	60	—
Weak UHF	35	—	—	28	26
Strong VHF	—	40	30	24	—
Strong UHF	28	—	—	13	43

Table 2. The distribution of aerial types throughout the VHF and UHF system. Note the unusual types for the UHF bands and the overall popularity of the Yagi. Even in weak UHF areas it is only slightly less favoured than the corner reflector.

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As you know we are 1,400 miles from Sydney and 1,800 miles from Melbourne, but last week I received excellent pictures on my experimental receiver from Sydney, Melbourne and Brisbane, which is also 800 miles distant and is the closest TV Station to up here (one session lasted 1½ hours, which is verified in Press and radio).

Well, so much for the results. I am using your VTT1 Tuner and a Mark II Video Strip, which was home constructed, and here is the greatest plug for your components, the set performed WITHOUT ANY ALIGNMENT of Tuner or I.F. Strip and I really think you due for many congratulations for such excellent pre aligned video and Tuner products.

With heartiest thanks,

Yours,

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Since the ratio of VHF and UHF data was consistently 2:1, the last three columns should be corrected slightly for accuracy. However, such is not necessary in view of the large ratios found under the per cent interference between VHF and UHF.

"Under general information it was learned that servicemen made an average of 6,450 calls per year: 71.5 per cent on VHF sets, 9.6 per cent on sets with UHF converters and 18.9 per cent on sets with combined VHF-UHF tuners. These figures again point out that the ratio of VHF and UHF data was consistently 2:1.

"Data can only receive its proper mark of importance if it is accurate. In this connection the committee included the following statement in its final report:—

QUITE THOROUGH

"'A close study of the servicemen's questionnaire indicated that those men who took time to answer the questionnaire were quite thorough. We received very few questionnaires incompletely filled out. There were, of course, a number of unanswered questions for those areas that had neither UHF, nor colour service, and this is the reason for the reduced response in those areas.

"In crosschecking the total result of various sections of the questionnaire, those which dealt basically with the same problem areas showed a very close correlation. Therefore, we believe this indicates that the serviceman did not just make haphazard guesses, but was particularly reliable in the way he went about answering the questions.'

"Although the sample size (the 730 returns) was a small percentage of the total number of servicemen in the United States and only those sets requiring servicing were reported on, the committee felt because the data was consistent, that the other servicemen and receivers were statistically represented."

Looking at all this data from the Australian viewpoint, there are a number of points worth considering. In regard to Table 1, the first point that is immediately obvious is the short range of the UHF system.

It would appear that a primary service area (i.e., the "Excellent" or "Good" reports) of less than 20 miles is available from this, as against approximately twice this distance for the VHF channels. Considered in terms of our own metropolitan area, this would put Sutherland, Liverpool and Palm Beach on the edge of the service area, not taking into account the problems of local terrain.

GREATER DISTANCE

Even more startling is the difference between the distances for a "Fair" picture. From somewhere around 55 to 65 miles we come down to 15 miles in the worst case. At the same time, there is a considerable difference in power in favour of the UHF system.

However, all this is not necessarily a condemnation of the system. On the contrary, for use in smaller population centres, which might not otherwise rate a channel allocation, such a system might be ideal. And the restricted range, far from being a limitation, could well permit more extensive sharing of channels than is possible on the VHF system.

Again on the credit side, we have Table 3, covering interference problems and this would appear to be most significant. In fact, a well designed UHF system covering a suitable area might well have the edge on the VHF system to a worthwhile degree, for this reason alone.

SOURCES OF TV INTERFERENCE

Tabulation of Interference Sources at VHF and UHF

	% reporting this kind of interference	% of these on VHF	% of these on UHF	% of these on both VHF-UHF
Ignition	86	92	1	7
Electric Household Devices	70	88	2	10
Amateur Radio Stations	63	92	2	6
Neon Signs	58	94	1	5
Diathermy	50	95	—	5
Power Services	45	89	1	10
TV Rec. Radiation	44	81	7	12
Police Radio	38	78	10	12
AM-FM Broadcast Stations	29	86	6	8
Shortwave Stations	29	91	3	6
Special Services	26	73	11	16
FM Rec. Radiation	21	87	7	6
Standard AM Rec. Radiation	9	85	7	8

Table 3. A comparison between interference on the VHF and UHF bands. In spite of differences in receivers in use, the difference in favour of the UHF is quite striking. A rather disturbing feature would appear to be the high rating of amateur radio stations.

It would also be interesting to know to what extent the limitations of receivers, particularly in regard to noise in the early stages, contribute to these limitations of the UHF system. It is probable that these are considerable, so there is always the chance that developments yet to come may change the picture drastically.

MORE CHANNELS

In any case, the fact that the UHF bands make available some 70 additional channels over the VHF bands (83 in all!) cannot be ignored in any large country with a high population density. We could well find ourselves in a similar position in a few decades.

In the matter of aerials, it is interesting to note the incidence of such unfamiliar types as the "Corner Reflector" and the "Bow Tie," both peculiar to the UHF systems. I was surprised that there was no mention of the rhombic, a type which was expected by many to come into its own on the UHF bands. On the other hand, the Yagi, while not the most favoured in every case, has a very good following right throughout the system.

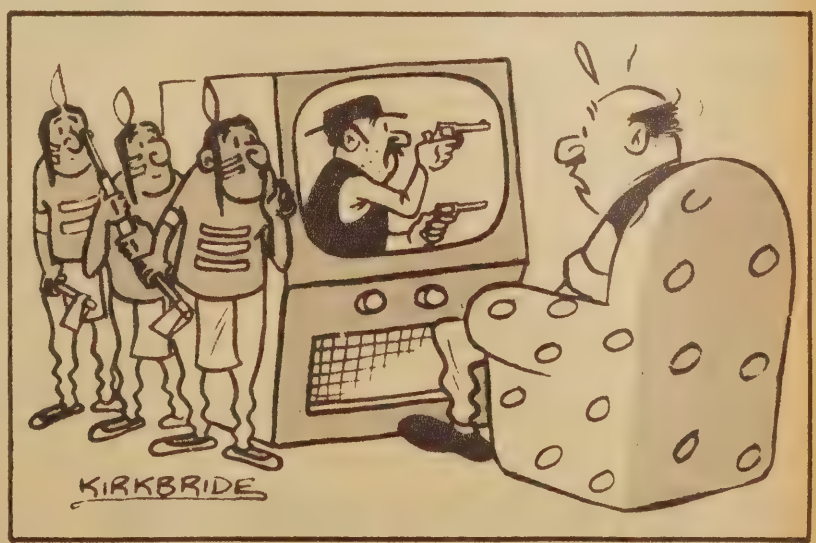
All in all, I felt it was an interesting sidelight on TV, from the serviceman's angle, in another country.

Coming back to TV in our own country, the following story is one which, when it started out, didn't look like being a story at all. The complaint was simply, "no sound," and I regarded it as a purely routine assignment. As it turned out, it wasn't a particularly difficult job, but it did have an unusual twist.

When I arrived on the job the owner confessed that he had ". . . been having a bit of a go at it," before he called me. I received this information with mixed feelings. While always suspicious of unskilled attempts at repairs, I was at least thankful that he had seen fit to tell me about it. There is nothing quite so frustrating as a set someone has "butchered" then passed on to the serviceman without a word of explanation.

SIMPLE ENOUGH

However, this fellow's fiddling sounded harmless enough. It seemed that all he had done was to replace the 6BM8 (combined audio and output stages) because the latter was suffering from some intermittent noisy condition of some



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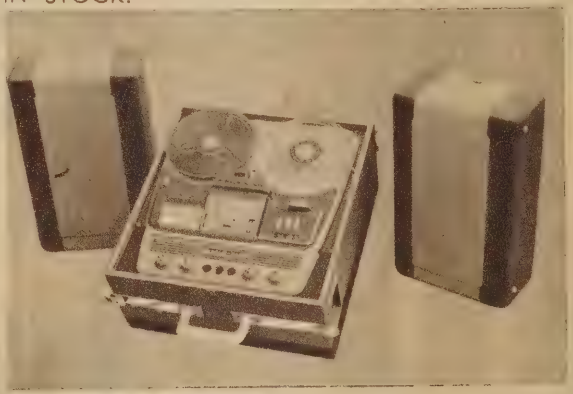

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kind. On the face of it I could hardly condemn such a simple action, particularly as he seemed to have some idea of what he was doing.

It seemed that this replacement had taken place about a week ago, and had apparently been quite successful. The intermittent noise had ceased and the set had behaved beautifully until just a few hours ago. Then the sound had simply stopped completely. The owner was worried about the possibility of the original trouble being something other than the 6BM8, and that the "cure" following the replacement might have been merely coincidence.

A NEW VALVE

Quite naturally, the first thing I tried was a new 6BM8, but the set remained as dead as ever. I put the original valve back and checked for any signs of screen overheating, as occurs when the speaker winding is open circuit. As far as I could see in the restricted space, there were no such symptoms. Fairly obviously, the chassis had to come out of the cabinet.

This was not particularly difficult, but the manner of fitting was such that the front of the chassis had to be lifted a couple of inches as soon as the shafts were clear of the cabinet and the whole thing withdrawn at a slight angle. As it ultimately transpired, this had some bearing on subsequent events.

With the set on its side on the lounge-room floor, I began checking voltages around the 6BM8. It took only a few seconds to establish that there wasn't even a smell of HT being applied to the audio system, leaving no doubt as to why the sound had failed.

This circuit, like many others, used a heavy duty wire wound 2000 ohm decoupling resistor between the main power supply and the audio HT line. It is a common culprit in this kind of fault, and I knew the chassis well enough to know just where to put my meter prods on it.

At least, I thought I did. But when I looked in the usual spot and found no resistor I began to wonder whether my memory was playing me tricks. Was I becoming confused in my old age and mistaking this chassis for another brand?

NO RESISTOR!

I quickly traced out the audio HT line from the 6BM8 circuit, finding myself back at the spot in the resistor panel where I had looked the first time — only there was no resistor. However, closer inspection revealed two short pigtails attached to the panel lugs, suggesting there must have been a resistor at some time.

My first thought was to accuse the owner of having tampered with the set to a greater extent than he had admitted, and I did get to the stage of casually inquiring whether he had removed the chassis from the cabinet for any reason. When he assured me he hadn't I realised I had to find some other explanation.

I even considered the possibility of the resistor having blown itself to pieces as the result of some freakish short circuit. While I have seen this happen, I couldn't imagine the effect being so complete that only the pigtails would be left. Somewhere there would have to be some wire, terminal bands, and scraps of ceramic former.

Acting on this idea I glanced into the back of the cabinet. And there, sitting serenely on the chassis shelf was the missing resistor. Far from being blown to pieces, it appeared to be quite intact. Admittedly, closer examination revealed that it had been severely overheated at some time, but it was still in one piece, both physically and electrically.

How did it come to be there? Apparently some kind of overload had heated it to the point where the solder holding the pigtails had melted and the construction of the resistor and angle of mounting were such that the solder was the only thing holding the resistor in place. When it melted, the resistor simply fell off the pigtails. (The fact that I had to lift the front of the chassis to get it out explains why I did not drag the thing on to the carpet.)

WIDE-BAND C.R.O.

In the circuit on page 75 of the February 57 issue, the .033 meg. resistor in series with the vertical shift control should be .33 meg. It is recommended that the control be of the linear type, rather than logarithmic.

I will admit the situation must have been an ideal one, since it would be far more likely for one end only to come adrift, thus breaking the circuit and allowing the solder to cool again. However, I couldn't deny the evidence of my own eyes and, when I drew the owner's attention to the circumstance, he offered some further comment.

"You know," he recalled, "I heard something drop inside the cabinet about the time the trouble started. I thought it might be something to do with it."

(I couldn't help thinking that it might have saved me a few moments of bewilderment had he thought to tell me this earlier.)

However, I still had to find why the resistor had overheated. My first bet was for a broken down decoupling electrolytic, but this proved to be quite intact. In fact, the entire HT line appeared to be free from any suggestion of a short.

This seemed to leave only the valve. I fitted a new decoupling resistor in place of the old one (the latter was pretty scrubby looking after its ordeal) switched on and reached for the test leads. As the set warmed up I measured first the main HT voltage and then the audio HT voltage, remembering that these should be in the vicinity of 260 volts and 190 volts respectively.

The main HT voltage was normal, but the audio line could only rustle up about 25 volts. What was more, nearly 20 of this was across the 400 ohm self bias resistor. Whatever the cause, the plate to cathode resistance was abnormally low, and most of the main HT voltage was being applied to the decoupling resistor. And, even in the few moments it took me to make these measurements, the new resistor was starting to smell and was obviously very hot. I switched off hurriedly.

INTERNAL SHORTS?

Substituting a new 6BM8 cured the trouble, restoring the sound and all the voltages to normal. I put the old one carefully to one side, both for closer examination in the workshop and for return to the makers under guarantee. Then I refitted the chassis, gave everything a final check, and took my leave.

Back at the shop I checked the valve for shorts. I fully expected to find a dead short from the cathode to either the plate or the screen, so I was rather surprised when all I could discover was a screen to control grid short. There is no doubt that this would cause the valve to draw a lot of current, the control grid being positive by the HT line voltage, but I doubted whether this would have been as severe as the symptoms indicated.

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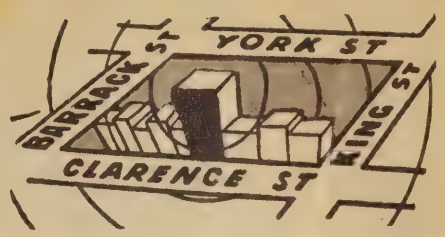

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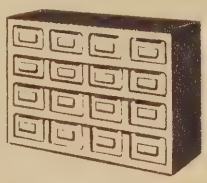

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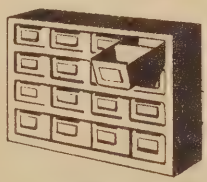

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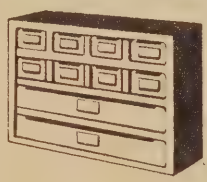

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I have a feeling the cathode must have been involved in the short when the resistor packed up, and even when I made my measurements. It seems probable that subsequent handling had shaken loose the scrap of foreign material responsible, leaving only the screen-to-grid short.

However, that was enough to justify sending back to the makers and claiming a replacement.

My final story concerns valve-type portable. It was one I had handled only about a week before, having fitted new batteries and given it a general once over for anything else in need of attention. There was, in fact, nothing seriously wrong with it and it had been performing perfectly when it left the shop.

BACK SO SOON!

I was somewhat disturbed, therefore, to find it back so soon accompanied by a note from the owner couched in what can only be described as rather aggressive terms. Whatever the trouble was, I felt it was particularly unfortunate that it had to happen to this customer; a rather difficult type who imagined that everyone was out to "do" him at the first opportunity.

In substance, the note pointed out that the set had failed less than a week after I was supposed to have overhauled it. The owner suspected the batteries and intimated that if this was so he felt that they should be replaced. And if it wasn't the batteries then it was something which should have been found when the set was checked, thereby implying that the overhaul had been less than complete and that this also should be my responsibility.

Well, one gets used to that kind of thing after a few years. There isn't a great deal one can do about it, except do one's best to explain the true reason for such situations; an explanation which I fear is seldom accepted as anything more than an excuse, no matter how accurate it may be. Still, I'm afraid that is one of the occupational hazards of the game.

In this case it took only a few minutes with the multimeter to establish that the batteries were delivering normal voltage and set drawing normal current. This cleared the batteries but, as far as the owner was concerned, placed the blame squarely on my shoulders.

AUDIO GAIN

The volume control contacts were readily accessible without disturbing the chassis, making it an easy matter to check the audio sensitivity. When I found this section completely dead I checked each of the audio valves in the tester. And there was the culprit; a dud 1S5. Subsequent examination showed it to have an open circuit filament.

All of which was delightfully simple as far as purely technical problems were concerned, but did little to solve the much more difficult customer relations problems. How would the owner react when billed with the price of a new valve plus a service charge, even though the latter might be made as moderate as possible?

As I expected, he was none too happy with the situation. Fairly obviously he could hardly complain about the price of the valve since, on his own reasoning, this should have been replaced the first time anyway. But he did complain about the additional service charge and considered this was adding insult to injury, seeing that he had been put to the inconvenience of being deprived of his set and having to bring it back to the shop.

I pointed out that, while I sympathised with him in the matter of this inconvenience, I could not accept responsibility for having caused it. The set had been thoroughly overhauled on the previous occasion and the valves had given no indication, either in the tester or by reason of their behaviour in the set, that any one of them was about to fail.

I went on to explain that many component failures were completely unpredictable and that valve failures of this kind were classic examples. There simply was no way of knowing that such a failure was about to occur, even a few hours before it happened. That it was, in short, just one of those things we had to accept as part and parcel of commercial electronics.

THE LAST WORD

But I could see he wasn't convinced. And he was determined to have the last word.

"Well," he grumbled, "what's the point in you testing them at all if you can't tell when they are going to fail? And why don't they make them more reliable anyway?"

I replied that, in the first place, there was plenty of point in testing valves, because many faults could be found and certain types of failure could be predicted. In fact the occurrence of predictable failures was many times higher than the unpredictable ones. This case was simply one of the unlucky ones.

Secondly, there was no doubt that engineers could turn out more reliable components, but only at considerably increased cost, and there was serious doubt as to whether this cost could be justified. As it was, manufacturers aimed to produce the highest possible order of reliability consistent with reasonable cost and for the most part, they seemed to have struck a good compromise between the two factors.

It would be plainly ridiculous for example, if, in an attempt to eliminate two or three per cent of premature failures, a manufacturer was forced to increase the cost of the component by three or four times. Yet such a condition could easily occur, the law of diminishing returns becoming very apparent as attempts were made to eliminate the last few per cent.

Fairly obviously, most people preferred the more reasonably priced component and were prepared to take the small risk involved. On an average basis it was far less costly than striving for perfection at a much higher cost.

Was he convinced? Frankly, I don't know. Maybe I had merely stunned him but at least I seemed to have scored a temporary victory, because he paid his account without further argument and left in a reasonably affable frame of mind. His only argumentative comment was to the effect that he hoped another valve didn't blow up in the immediate future.

I said I hoped so too.

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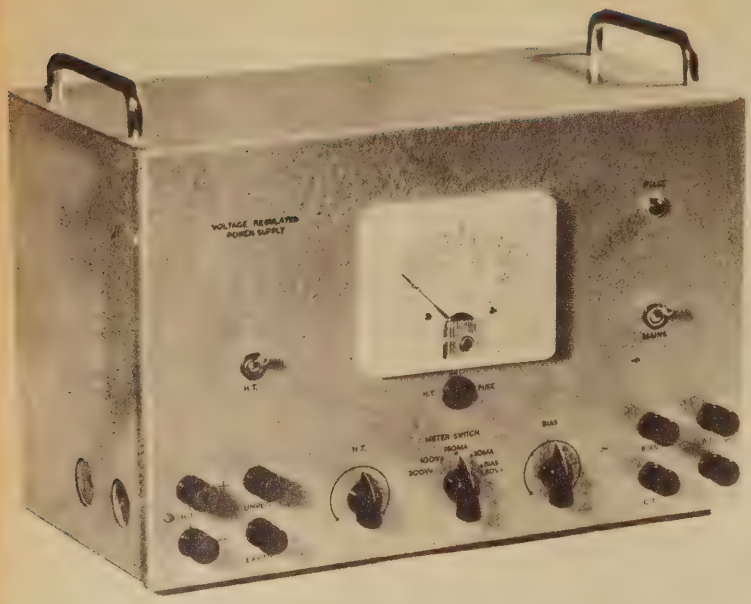

A front view of the completed supply. The two H.T. sources are available from terminals at left, heater and bias supplies from the right.

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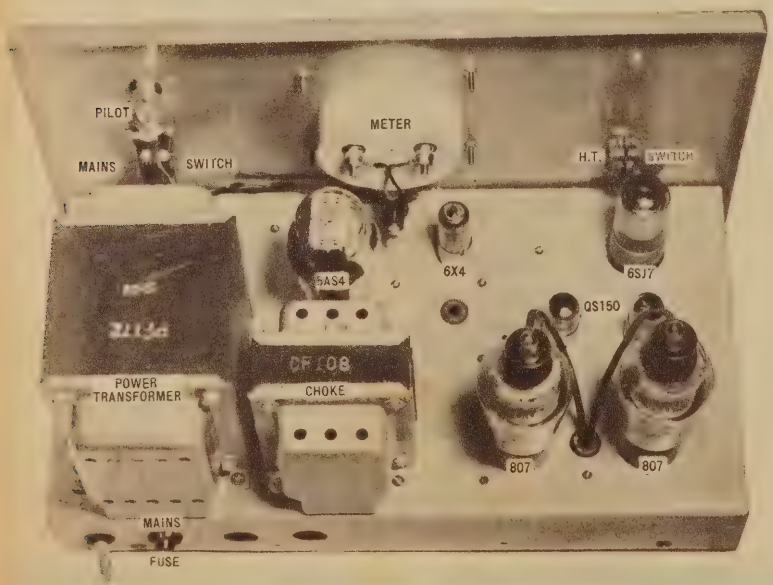

A top view of the chassis. Power supply components are at left, bias rectifier near meter, DC amplifier at front right, with regulator and 807 valves nearer camera.

By John Barker

THERE are two aspects to consider: One is the desirability of having a variable plate supply for the many experimental circuits that are necessary in the production of electronic gear and the other of having a supply that is essentially independent of variations in the line voltage and in the load.

During the design and production of the many and varied pieces of electronic gear which we have undertaken, it has often been necessary to connect some experimental hookup to a temporary source of power.

Usually it has been taken from the pre-amp. socket on one of our standard amplifiers and, needless to say, half of the time this voltage is not quite right and that entails more fiddling. In general it is a most unsatisfactory procedure.

On the other hand there are many applications of electron tubes, for instance; oscillators and measuring instruments, wherein it is necessary to provide direct voltage which will remain constant under all conditions. Also the excellent regulation possible with a supply of this nature results in an effective power supply impedance of only one or two ohms. For any class B application this is an important consideration.

All these features have been incorporated in our design. It is possible, of course, that individual users will not require that the supply be fully variable over the whole range, rather that it regulates at some set voltage; similarly there will be others who will have more use for a fully variable supply without the good regulation. Either of these reservations allow of a simpler approach and this will be considered.

The unit to be described delivers from 0 to 300 volts at currents up to 120mA, provides a bias, variable up to 30 volts and 6.3 volts AC centre tapped. It is fairly easy to construct and the layout and adjustments are generally not critical.

Firstly we must consider the theory of operation of the supply, since an understanding of its workings will allow individuals to adapt the design to suit their own requirements.

Essentially, the supply is in the form of an electronic voltage divider across a source of DC. This is shown in Figure 1. The variable resistance R1 is provided by a "series" or "pass" valve, as it is called, whose effective resistance is varied by changes in the grid voltage.

One method of bringing about this condition is shown in Figure 2. Here the bias on V1 is varied by altering the position of the slider on the variable resistor R2. This is not a fully auto-

matic regulating supply but it is handy as a variable source of plate voltage. Any power valve can be used here.

The important thing to watch is the plate dissipation in triode connection. It is only likely to be exceeded when large currents are drawn at low output voltage. Under these conditions the voltage across the valve is high and the plate dissipation (the product of this voltage and the current) is maximum. Further design considerations are given below.

In this circuit a small change in the grid voltage results in a large change in the plate current, which, in turn, results in a large variation in the output voltage appearing across RL.

AUTOMATIC CONTROL

Now, as the load resistance varies, so will the voltage across it vary in proportion. If this load voltage variation is fed back to the grid in such a way as to oppose the change (by altering the voltage divider ratio) a measure of automatic control will result.

To obtain effective control, it is usual to interpose a DC amplifier stage in the voltage feedback circuit.

Such an arrangement is shown in Figure 3. Here a DC amplifier is interposed between the grid and the 807 series valve and the divider resistor R2. Also a gas-filled regulator tube has been added between cathode and ground of the amplifier.

This "VR" tube maintains across itself a constant voltage over a very wide range of current drawn through it. It is thus a reference tube, whose voltage is "compared" to the output fluctuations by the DC amplifier.

Resistors R5 and R6 supply current to the VR tube so that its correct voltage is always maintained, as well as providing a suitable screen voltage for the 6SJ7.

The plate of the 6SJ7 control valve is supplied through R1 from the full high-tension supply. The plate will therefore be normally negative with respect to the HT line by the drop across R1, this drop being determined by the current being drawn by the 6SJ7.

Since the grid of the 807 series valve is tied to the control valve plate, the potential of the latter will also represent the voltage (or bias) at the 807 grid. Thus the plate current of the control valve affects the bias on the series valve, therefore the voltage drop across this valve, therefore the final HT output voltage.

EFFECT OF BIAS.

In terms of output voltage regulation, the circuit works in the following manner: Suppose that the output voltage tends to rise, due to a decrease in the load resistance. The voltage Eg applied to the grid V1 becomes slightly more positive with respect to the cathode. The plate current increases and the voltage across R1 also increases, thus making the grid of the series valve V2 more negative. The consequent rise in resistance of the series valve reduces the output voltage to the correct value.

The exact value at which the output is held depends on the setting of the sliding contact on resistor R2.

In order to reduce the output voltage to zero, plate current in the series valve must be cut off completely. In this circuit it cannot be done. To explain this we must refer to Figure 4.

It will be seen that the amplifier valve and its load resistor R1 form a voltage divider across the input DC voltage. The ratio of this divider determines the bias applied to the series valve. Rv is the residual resistance of the cathode-to-plate path of the amplifier and it will be minimum when the amplifier has the least negative bias on its grid.

Since, with a practical valve, Rv can never be reduced to zero, the grid of the series valve can approach but never reach the potential of the negative input line. A certain minimum positive potential must always be evident at the grid.

This means that the series valve must continue to conduct in some degree, developing voltage across the load circuit RL.

Any other assumption would clearly

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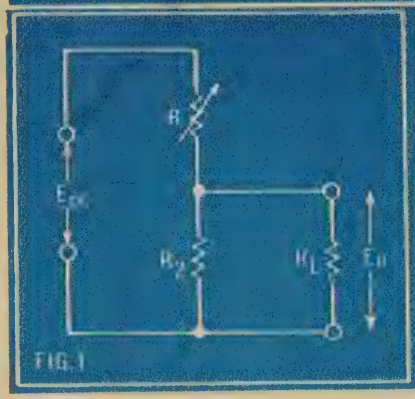
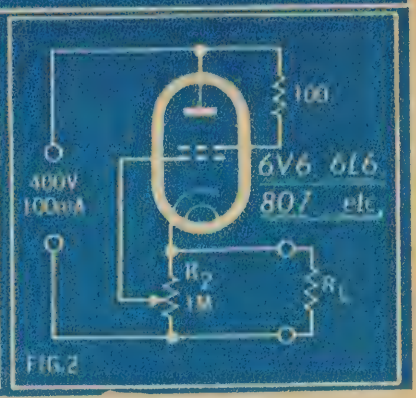
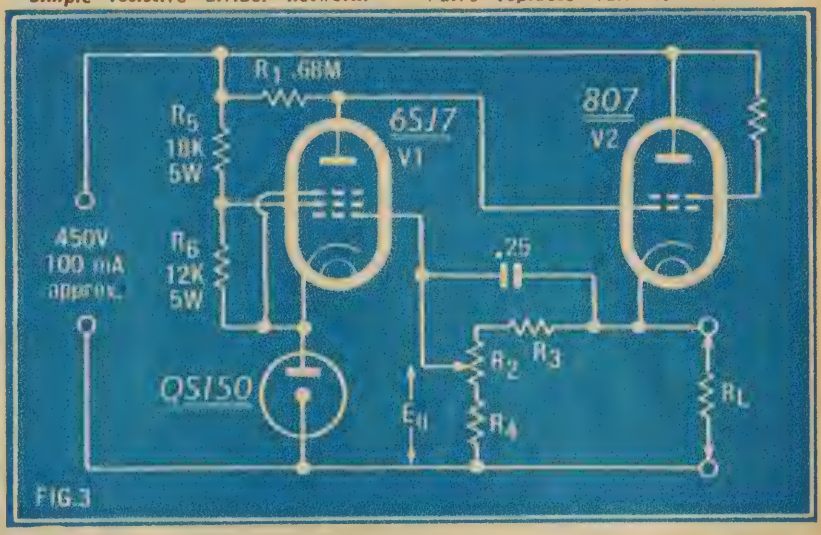


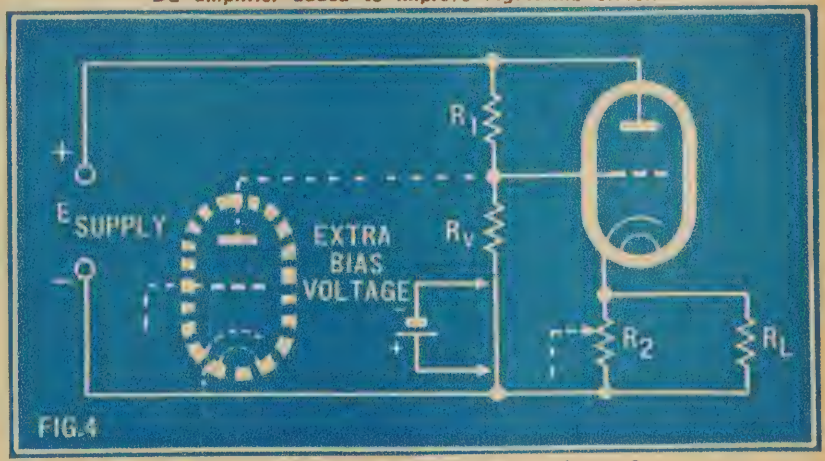
Simple resistive divider network.



Valve replaces variable resistor.



DC amplifier added to improve regulating effect.



Showing the essential configuration of figure 3.

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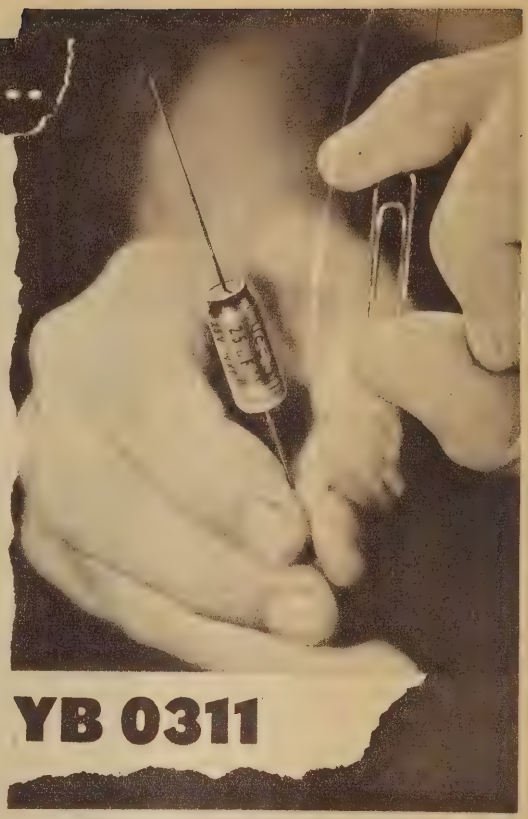

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be invalid. If one assumed no current through RL and no voltage drop across it, the cathode would be at the negative line potential. One would therefore be left with the unlikely situation of a valve, with 400 volts or more on plate and screen, and positive grid bias, not drawing any current.

In practice and by ordinary "follower" action, the cathode will always assume a potential somewhat more positive than the grid. Thus the minimum voltage present across RL in figure 4 will always be slightly in excess of that set by the ratio of Rv and R1.

If current through the series valve is to be cut off, then its grid must be carried, not merely to the potential of the negative supply line, but sufficiently beyond it in a negative direction to achieve such cut-off. In other words, a supplementary negative bias must be provided and applied.

EXTRA BIAS

The magnitude of this extra bias voltage will be roughly equal to the cut-off bias plus the voltage drop across the equivalent resistance Rv.

However, the supply, as it stands in Figure 3, without the extra biasing components, is useful for the stabilisation of oscillators, meters, etc., where extreme variations in output voltage are not required. As it is, the voltage can be varied by about plus or minus 100 volts depending on the current drawn.

The resistors R3 and R4 on either side of the control potentiometer are selected so that the latter just covers the required range. They are best found by trial and error as explained later.

The capacitor connected between the cathode of the 807 and the amplifier grid is an additional hum reducing component. Its reactance should be low with respect to the resistance which it shunts, so that the full hum voltage from the power supply is fed to the amplifier grid. It should not be too low, however, or some oscillation may be developed due to over-compensation by the amplifier.

If full control of the output is required the basic circuit shown in Figure 5 may be used. This, in fact, is a re-arrangement and simplification of the final circuit shown on page 61.

It will be seen that an additional bias voltage is necessary as well as the supply voltage. The two VR tubes are in series across the bias supply, whose voltage is held constant at some value depending on the particular VR tubes in use. The control potentiometer is returned to this negative supply rather than to earth.

EQUIVALENT FUNCTIONS.

VR1 performs the same function as the VR tube in Figure 3, being the reference voltage source. VR2 provides a constant bias voltage between the cathode and grid of the series tube. The negative bias voltage may be derived from the main HT winding of the power transformer by the use of a half-wave rectifier. This is seen in the main circuit.

Now having decided on the basic circuit necessary, the next step is to design the supply for the individual need. This can be pursued in a fairly logical manner.

Firstly we have to decide on the output voltage and current and whether or not full control is required. For the usual run of laboratory testing of small amplifiers, instruments, receivers, etc., 300 volts is quite adequate at a current of around the 100mA mark. With smaller

HOW FINAL CIRCUIT OPERATES

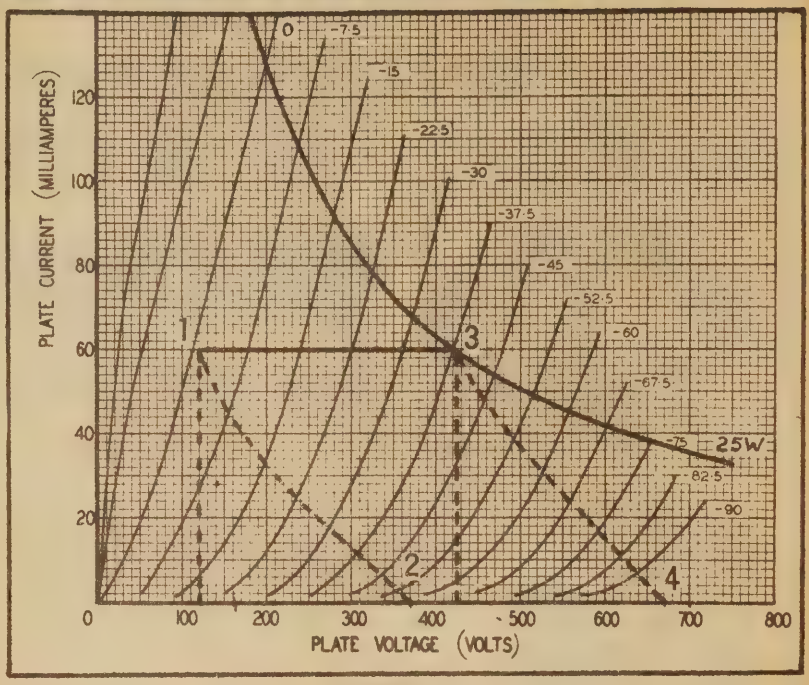

Figure 6 (above): A plate family of curves for the 807, triode connected. The curved line at upper right shows dissipation limits, the rectangle at lower left the operating region for the present application.

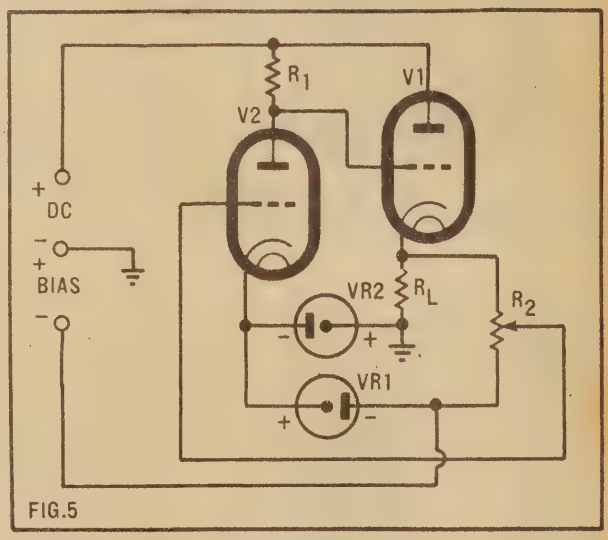

Figure 5 (right) shows the basic configuration of the proposed regulating circuit.

voltages, say the commonly used 250, a slightly higher current may be drawn.

For the maximum versatility it was considered necessary in our case to provide for the full range of output voltage. There are many circuit elements designed to work with voltages of 50 or 100 volts, and a wide variation of voltage is desirable when observing valve operation, etc.

The pass tube must next be considered in view of the output requirements. The main things are the maximum current and the plate dissipation. The maximum dissipation occurs when high current is drawn with low output voltage. As the output voltage falls, so the voltage across the series tube rises. The maximum current and the minimum voltage output thus determine the choice of the pass tube.

Special valves are available, designed for this very purpose, such as the RCA type 6AS7-G; this handles currents up to 250mA. It is a twin power triode and the two sections are run in parallel. The price is about 55/ trade. However, there are other considerations.

The 807 is another valve which works well in this application, though it was not designed initially for this service. Thousands of them were available through disposals, very cheaply, and many readers will have them on hand. If we examine the plate characteristics for this valve we can determine the limits of operation.

Because of the configuration of the circuit, series valves are normally operated as triodes. The screen is connected to the plate and then the screen dissipation adds to that of the plate which is an advantage. The 807 plate curves, for triode connection, are shown in Figure 7. The maximum plate and screen dissipation is given as 25 watts and the parabolic line across the curves represents this condition.

The grid bias voltage cannot be allowed to become positive, otherwise

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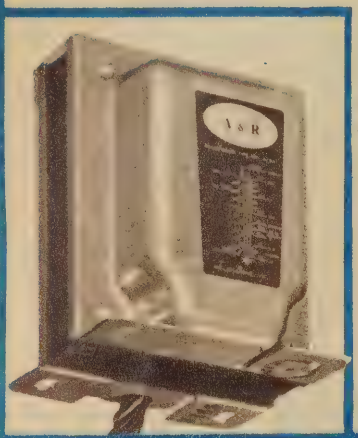
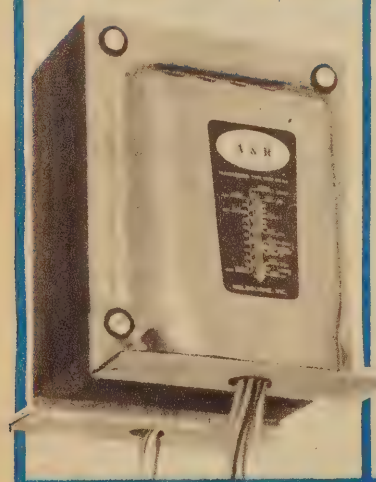


VLN 34 Mounting 60-125 mA



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Type P. T.	D.C. mA.	H.T. Volts Per Side	Rect. Fil.	Other Fils.
1992	30	150-0-150	—	6.3v. 1.7a.
1993	50	225-0-225	—	6.3v. 2a.
1880	60	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1881	60	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1882	60	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1883	60	385-0-385	5v. 2a.	6.3v. 2a.
1884★	80	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1885	80	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1886	80	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1887	80	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1888	80	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1889	100	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1890	100	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1891	100	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1892	100	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1893	125	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a, 6.3v. c.t. 2a.
1894	125	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1895	125	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1896§	150	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.

Type P. T.	D.C. mA.	H.T. Volts Per Side	Rect. Fil.	Other Fils.
1919†	125	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2.5a.
1927	125	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1928	150	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1929	150	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1930	150	350-0-350	6.3v. 1a. tap at 5v. 2a.	6.3v. 3a., 6.3v. c.t. 3a.
1931	150	385-0-385	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1932	175	285-0-285	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1933	175	325-0-325	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1934	175	350-0-350	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1935	175	385-0-385	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1783	180	410-0-410	5v. 3a.	6.3v. c.t. 4a., 6.3v. c.t. 5a.
1936	200	285-0-285	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1937‡	200	300-0-300	5v. 2a.	6.3v. 3a., 6.3v. c.t. 3.5a.
1938	200	350-0-350	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1939	200	450-0-450	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.

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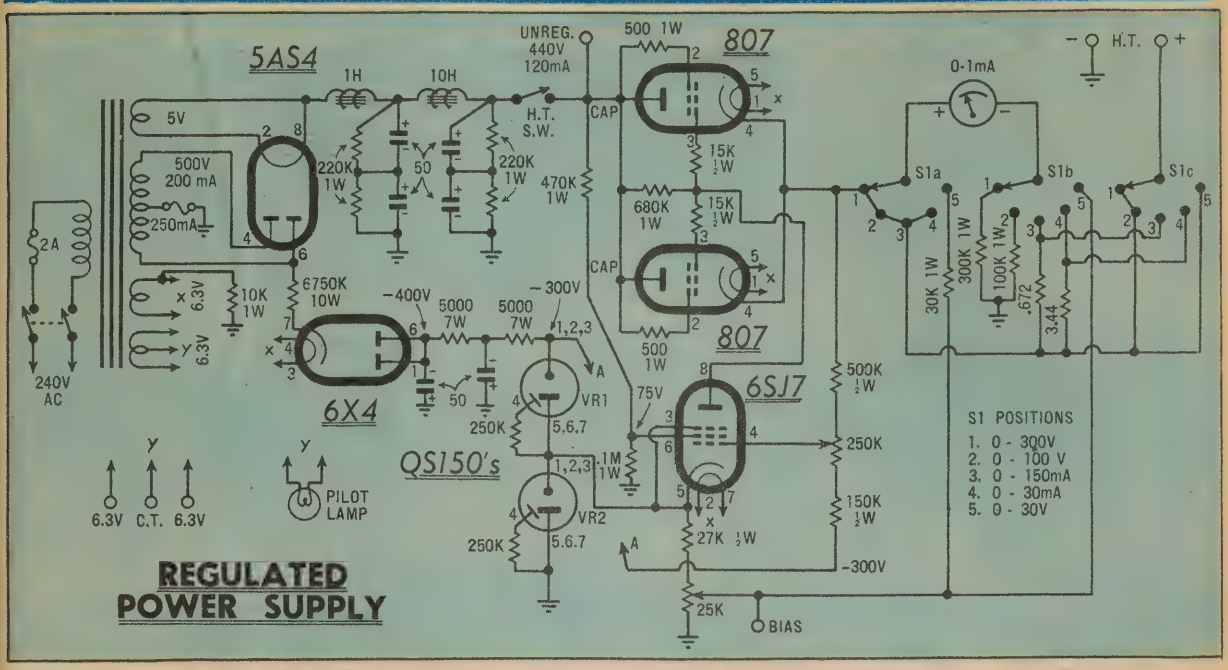

Here is the circuit of the complete supply. It provides regulated and unregulated HT output, bias and heater volts. Note that the negative HT line is independent of chassis for DC. Metering is provided for, which can be extended or omitted according to individual needs.

grid current will be drawn, so the series valve must be operated wholly within the area to the right of the zero bias line and below the 25 watt dissipation line.

The maximum plate current is given as 80mA but in the interest of tube life a more conservative value of 60mA has been suggested. This means that two 807's in parallel can supply 120mA between them, with the possibility of exceeding this figure for brief periods.

There are four points of operation of the supply which between them give the input voltage and bias necessary for the correct operation of the series valve. They refer to the output and are as follows:

1. Maximum voltage
   Maximum current
2. Maximum voltage.
   Minimum current
3. Minimum voltage
   Maximum current
4. Minimum voltage
   Minimum current

For point 1, in our case, the maximum voltage and current will be 300 volts and 60mA per valve. At this point there will be the minimum volt drop across the 807 and therefore the least bias. In order to prevent a waste of voltage across the 807, zero bias is the obvious choice. This point and the others are indicated on the 807 curves.

UNREGULATED SUPPLY

For zero bias and 60mA, the voltage drop across the 807 is about 120 volts so that the unregulated supply to the 807 plates must be about 420 volts.

Point 3 is found by moving along the 60mA level to the 25 watt dissipation line. The 807 volt drop is now about 420 volts. This means that it is possible still to draw 60mA at very low output voltages without exceeding the dissipation. In practice this would be a very unusual requirement of the supply.

The exact positions of points 2 and 4 will depend on the regulation of the input supply. If this input is 420 volts at 60mA (120mA for the two 807s) then the voltage will surely rise as the load is decreased.

REGULATION IMPORTANT

If the regulation of the input was perfect, so that the voltage remained at 420 volts for all load currents, the points 2 and 4 would lie below the points 1 and 3 as is shown dotted on the curves. As it is, points 2 and 4 move farther and farther to the right as the regulation of the input becomes poorer.

The important thing to observe is that for point 4 the full supply voltage appears across the 807s. There is no current being drawn so the dissipation will not exceed the rated value, but the voltage may exceed the maximum breakdown value. It is therefore necessary to pay some attention to the design of the supply in respect to the input voltage.

One important consideration in this regard is whether or not the unregulated output, at the plates of the series valves, should be made available at the front panel of the supply as an additional source of supply. This is often a handy facility when a higher voltage than the normal output is required, and the regulation is not so critical.

If this is the case then the hum content of the voltage may be more important than the regulation. If a simple choke input filter is used the regulation will be good and this will suit the requirements of the series valve, but the filtering will not be so efficient.

On the other hand, the regulation of the capacitor input filter is poorer but the filtering is better, making the unregulated output more useful in this respect. As so often happens, the choice is a matter of compromise.

The choice of a suitable transformer and rectifier is then the next step. For our purposes, it is generally preferable to specify standard components wherever possible so, with this in mind, we decided to try a transformer which was originally designed for use in Williamson type amplifiers. They were made in large quantities and should be freely available. The H.T. secondary produces 500 volts per side at 200mA and there are adequate L.T. windings.

There are several rectifiers suitable for this application. The 5AS4-A or 5U4-GB is one possible choice. It is used extensively in television receivers. The peak inverse voltage is given as 1,550 volts. For choke input to the filter, and using a 10 Henry, 150mA choke, the output voltage is about 420 volts. With capacitor input, using 40 uF capacitors the output will be about 580 volts. Both of these voltages are obtained from the published rectifier curves and are for a load current of 120mA.

CHOKE INPUT

The choke input arrangement therefore gives just enough input to provide the desired output under theoretical conditions but it leaves no margin for either component variations or low line voltage.

On the other hand the capacitor input produces far too much output and the regulation is not as good. One solution would be to use a transformer with a secondary of about 550 volts per side. This will produce the right voltage with choke input. However, we still wished to use the standard transformer so we tried a second choke in the position shown in the main circuit diagram.

This 1 Henry choke, at the input to the filter, is a type used in many tele-

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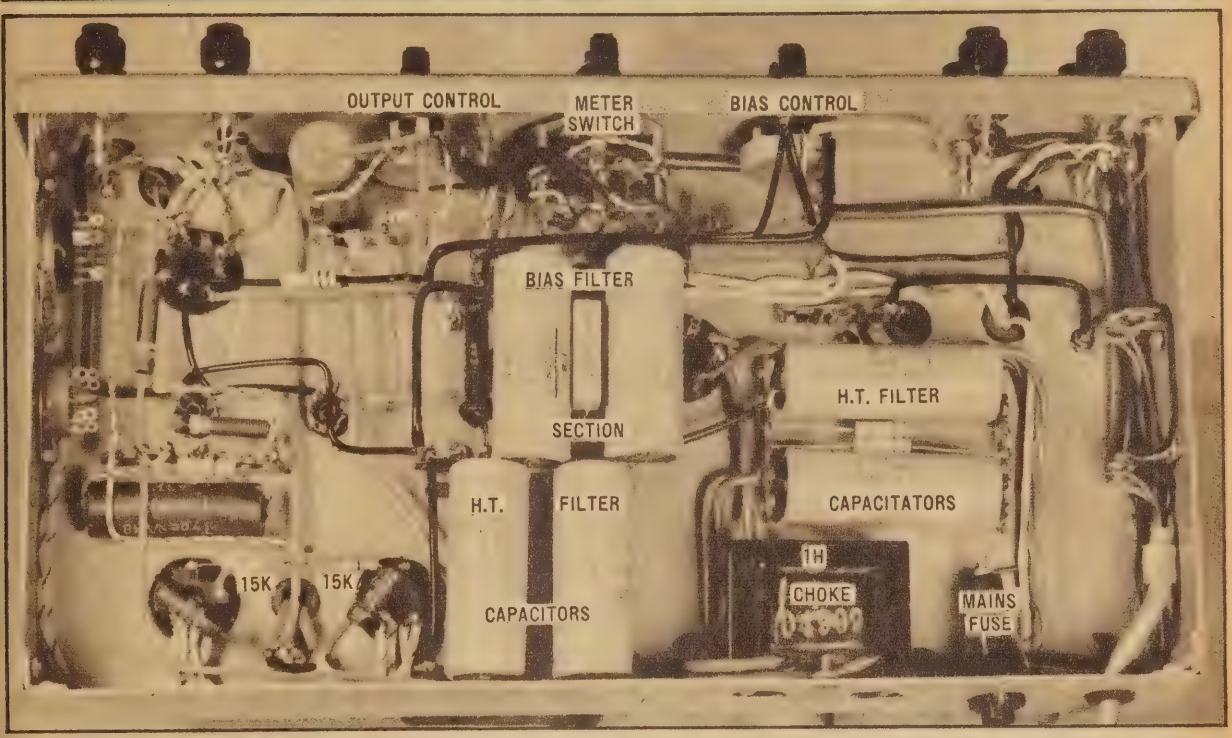

Space underneath the chassis is occupied but not overcrowded. Note the 1-Henry choke and fuse attached to the rear face. Note also the series pairs of electrolytics. The sockets at the left hand end can be wired to facilitate connection of frequently used items.

vision receivers and is rated at 175 mA. It is followed by a standard capacitor input filter using the 10 Henry choke. This partial-choke input, two section filter, is an excellent compromise and the output voltage is just right at about 440 volts, again at 120 mA.

ALTERNATIVE RECTIFIERS

Other possible rectifiers are the GZ32 and GZ34. These are low impedance types with rated peak inverse voltages of 1,400 and 1,500 volts respectively. It is possible to obtain slightly better regulation figures with these valves, when used with a choke input filter, because of the lower power supply impedance. In this particular circuit the GZ32 would be working at maximum ratings and so would not be the best choice. For lighter applications it would be quite good.

The ratings of the GZ34 are somewhat higher. In fact they seem just a little optimistic considering the physical size, but the load in this case is well within the published ratings. The GZ34 with the one section choke input may just produce sufficient voltage to suit this circuit but the margin would still be uncomfortably small.

The DC amplifier and the associated circuitry is the next consideration. The main thing here is gain, therefore a pentode is best, and a wide choice is available. The 6AU6, 6SJ7, 6AC7, 6SH7 are some suggested types.

It is usual to make the plate load resistor large for high gain, though a limit is set as the load approaches the nominal plate resistance and/or the plate voltage falls to a very low figure. The screen divider resistors are arranged to provide about 100 volts at the screen.

The choice of the voltage regulator, VR2, depends upon the cut-off bias for the 807s. This is found from the plate curves. With the full supply voltage of about 670 volts across the 807, approximately 100 volts of bias is required. To this must be added the residual voltage across the amplifier valve when fully conducting. This should not exceed about 40 volts. Therefore a standard 150 volt regulator should suffice.

VR1 should have as high a voltage rating as possible so as to subject the amplifier grid to a large proportion of the output voltage fluctuations. Therefore the VR150 is again the choice. This means that the negative supply must develop somewhat more than 300 volts.

STRIKING VOLTAGE

The operating voltage of the two VR tubes totals 300 volts, but the striking voltage is greater than this and depends on the individual regulator. We have chosen to use the English Electric QS150/15 regulators because of small physical size and low current requirements. However any other 150 volt types may be substituted with appropriate circuit adjustments.

The operating current range of the QS150 is from 2 to 15 mA.

The variations in this regulator current, in this circuit, will be almost wholly due to fluctuations in the mains. The small change in the plate current of the 6SJ7, which flows through VR1, will be less than a milliamp and can be ignored. Therefore the standing regulator current must be adjusted for normal mains voltage, so that any expected variation in this voltage will not move the regulator current outside its operating range.

With the circuit values shown, the standing regulator current is about 11 mA and this drops to 5 mA for a mains voltage of 200 volts.

The rectifier supplying the regulators is a 6X4 half-wave connected, utilising one half of the secondary winding.

The peak inverse voltage for this valve is given as 1,250 volts, which is somewhat less than that produced by the 500 volt winding. We have therefore connected a 6.7 K ohm, 10 watt resistor to reduce the voltage applied to the rectifier. With the remaining filter values shown, the no-load striking voltage is about 340 volts which is adequate for the regulators used.

We have used 450 volts working, 50 mfd electrolytics for all the filtering. For the main H.T. supply it is necessary to connect two in series because of the high voltage. The 0.22 megohm resistors are required to insure that the voltages across the capacitors remain equal, since the leakage of electrolytic capacitors may vary considerably.

It will be seen that the filaments of all but the 5AS4 are fed from the same winding on the transformer.

WORKS IN PRACTICE

At first sight this may appear dangerous, because of the high voltages existing between the several cathodes and the filament winding. However, provided the filaments are not directly earthed anywhere, there should be little danger of a destructive short-circuit.

So as not to leave the winding completely floating, we have connected a

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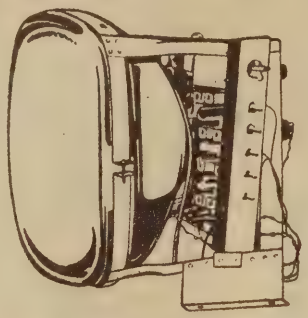

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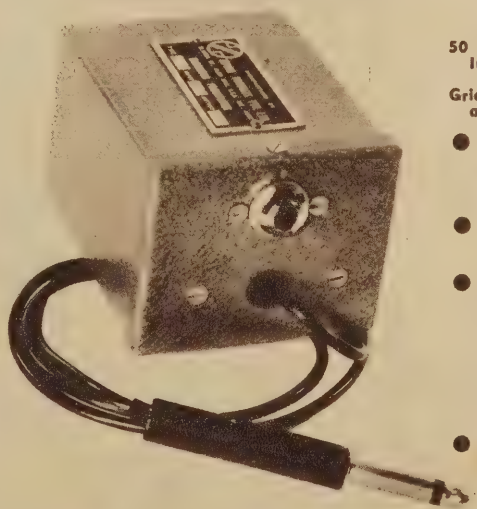

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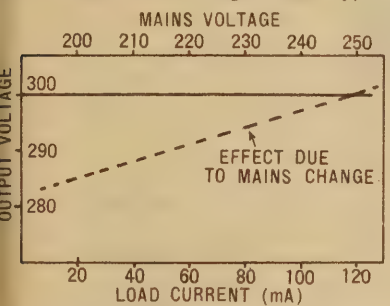
10K resistor between the filament winding and ground.

The situation could arise where some small leakage developed between the 807 cathodes and the filament. If the filament winding were not tied to a ground in some way, its potential could rise to that of the 807 cathode; when the polarity of the voltage aplied to the 6X4 cathode swung to negative, there would be a total voltage of about 880 volts between the cathode and filament of the 6X4, instead of merely the AC component.

If it is considered worth the extra cost and trouble, by individual builders, an extra filament transformer could be incorporated. This would need to have appropriately high breakdown ratings and at least two windings. Actually, we



These curves show the relationship between output voltage, load current and line voltage.

have had no hint of trouble with the system as it is.

The control potentiometer is connected between two resistors which determine the range of control possible. They are best found by trial and error. The total voltage across these three resistors will rise to a value equal to the negative bias plus the output voltage, so that the total resistance must be high enough to limit the power disipation to within the resistor ratings.

The usual rating of carbon potentiometers is a quarter of a watt. If this is exceeded rapid deterioration will result. It is this rating which determines the total resistance.

In our case the greatest voltage will be 600 volts, so that about 1.0 megohm total resistance will be sufficient.

TO SET NETWORK

To set the network, the best procedure is to connect a 1.0 megohm pot. between the positive output and the negative supply with the moving arm temporarily at the negative end. Connect some load device which will draw the maximum current at the maximum voltage, across the output and move the sliding arm of the pot. towards the positive end.

When the output voltage falls to a point just in excess of the maximum desired, switch off and measure the resistance between the lower end and the moving arm. This is the required value of the lower resistor.

Switch on again and move the slider till the output falls to zero. The resistance remaining between the slide and the top end is the value for the top resistor. The difference between the sum of the two resistors thus found and 1.0 megohm is the value of the control pot.

While the figures so obtained may be odd values, their ratio will be evident and it should be possible to instal avail-

(Continued on Page 109)

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Please see our other advertisement in this issue for other titles we stock, but which are not as generally available as those above.

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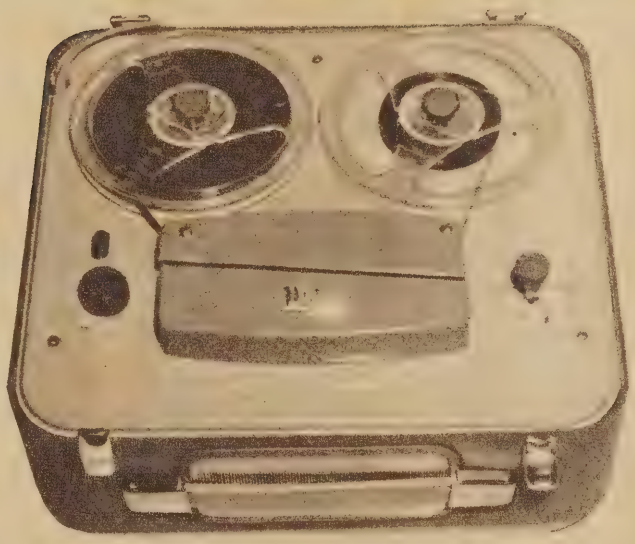

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3 MONTH GUARANTEE!

- ★ Famous Walter all-in-one "Joystick" control for Record/Playback and Fast Winding operations.
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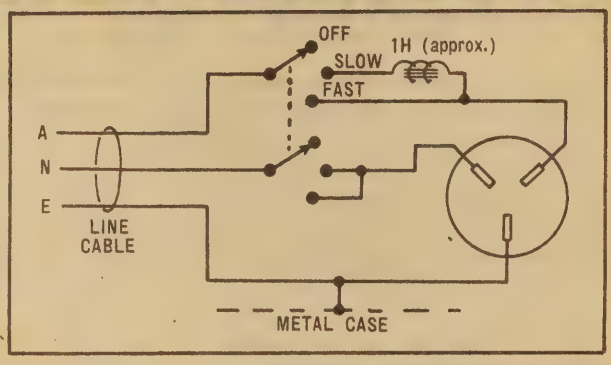
MAINS VOLTAGE 6 OR 12 VOLTS	AC only 200/250 volts. 50 cycles per second. (through invertor).
CONSUMPTION	50 watts.
VALVES	Mullard Miniature.
DECK	WALTER MK. I.
HEAD	Twin track Micro Groove CCIR and Continental sensed.
REEL SIZE	5in.
TAPE SPEED	3¾in per second.
RECORDING AND PLAYBACK TIME	600ft Standard Tape — 1 hour — 30 mins. per track. 900ft Long Play Tape — 1½ ho — 45 mins. per track. 1200ft Double Play — 2 hours.
SPEAKER	High Flux 5in speaker.
OUTPUT	2 watts.
OVERALL FREQUENCY RESPONSE	60-7000 cycles per second.
OVERALL DIMENSIONS	11¾in x 11in x 6½in.
WEIGHT	17lbs.

RUNNING FANS AT HALF SPEED

Have you ever been kept awake on a hot summer night by the buzz of the very fan intended to help you get off to sleep? If you have, you've probably wished for some means of running the fan at a reduced speed. Here is a device which can restore your slumber.



The circuit is simple but care is needed in the construction — it is handling 240 V.A.C.

MOST small desk-type fans are equipped with shaded-pole induction motors of from 10 to 40 watts, which are, to a considerable extent, voltage-sensitive. The method of speed control which suggests itself as being easiest, therefore, is that of inserting a series impedance in the line cord.

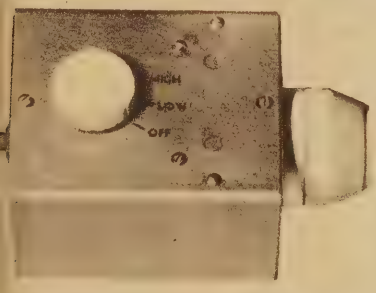
Three types of "impedance" are available, so, at first glance, we have a rather wide choice. A resistor would seem the simplest type, and on trying various values, a figure of 300 ohms was found to slow the fan to a suitable speed. However, as the fan used was a 30-watt type, about 16 watts of heat was dissipated in the resistor.

Since a reasonably small box size was desired, this method was found to be unsuitable since, even with a ventilated metal type box, heat was excessive.

A capacitor was then considered and a value of 8 microfarads decided upon, as this has an impedance of roughly the desired value at 50c/s.

When the capacitor was tried, however, resonance effects were found to occur, involving the inserted capacitance and the inductance of the motor. Indeed, with this value of capacitance, the motor actually ran about twice as fast as normal!

Even with a value of 2 microfarads, which was found to give a satisfactory speed, the measured capacitor voltage



High-speed, low-speed or off are provided by this control box.

was found to be 350 VAC, which is rather too high for commercially available units. Incidentally, if you intend to try the effect of capacitors, two electrolytics allow you to obtain large values for A.C. working. Connect them in series, but in opposite polarity.

The last choice was an inductor, mainly because of the size problem. A value of I-Henry was calculated as being near to the mark, so a filter choke of the I H, 275 mA, television receiver variety was found and wired into circuit.

Everything now worked well, except for one small point; the fan now ran rather too slowly! After unsuccessfully trying a "shorted-turn" gimmick, a simple solution to the problem was found. The particular choke used, a NATIONAL RH I/275, was easily taken to pieces, and the insertion of three extra pieces of paper into the core gap produced the desired result.

The effect of the increased air gap is to increase the reluctance of the magnetic circuit, so reducing the inductance and hence the A.C. impedance. This fiddling with the core, however, will depend on the particular fan in use and it may be that, with the type of fan you possess, no alteration will be necessary.

If, however, you find that the device does not slow your fan sufficiently, interleaving the E and I laminations, to reduce the air gap, will provide more impedance. Failing this, a choke of slightly higher value may be available.

The device shown in the photograph was assembled in a small metal utility box marketed by Messrs Watkin-Wynne and is the type used for small resistive loads, etc. The small choke and the Oak switch fit snugly into the upper portion and the three-pin outlet on the side of the lower portion.

The Oak switch is a three-pole, three-position type and is a single wafer. It is wired as a two-pole switch, thus making it safe for bedside control. The circuit used is quite simple and should present no difficulties. The line cord is passed through a grummeted hole and is knotted to prevent straining the wiring.

As a safety precaution, we suggest bonding the earth wire to the case as it passes through.

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Resistance: 0/10/100K ohms.
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32 VOLT RECORD CHANGERS 4-Speed Garrard RC-88. **£34/2/6.** Freight forward.

HIGH QUALITY AMPLIFIER YOU CAN AFFORD The W.F. 4 watt Amplifier will give superb reproduction from any of the popular pick-ups. An output transformer to suit speakers from 2 to 4 ohms, or 15 ohms impedance, is built in. Please specify impedance required. PRICE — complete ready to use **£16/19/6.**

New model now available similar to above but with extra EF86 Pre-Amplifier for use with microphone. Incorporates mixing circuit with individual volume controls for both pickup and microphone. Price complete ready to use **£22/10/.** Freight: Vic. 2/9, Int. 6/.

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VERTICAL CHANNEL
Sensitivity: 0.025 volt (RMS) per inch at 1 kc.
Frequency Response: Flat within plus/minus 1 db from 8 cps. to 2.5 mc Flat. plus 1.5 to minus 5 db; 3 cps to 5 mc. Response at 3.58 mc minus 2.2 db. (All response measurements referred to 1 k.c.)
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Sensitivity: 0.3 volts (RMS) per inch at 1 kc.
Frequency Response: Flat within plus/minus 1 db 1 cps to 200 kc. Flat within plus/minus 3 db 1 cps to 400 kc.
Attenuator: Low impedance type in cathode follower output.
Input Characteristics: Selector switch permits use of external input through panel terminal, line-frequency sweep of variable phase or internal sweep from sweep generator.
Horizontal Positioning: DC type: permits wide range of positioning to examine any part of trace even with full Horizontal gain.
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HEATHKIT V7A VTVM KIT

Specifications: DC Volts:—7 ranges 0-1.5 to 0-1500. Input resistance — 11 megohms. Sensitivity — 7,333,333 ohms per volt on 1.5 V range. Accuracy plus minus 3% full scale. AC Volts:— 7 R.M.S. Ranges 0-1.5 to 0-1500. Frequency response (5V Range) plus minus 1 DB, 42 C.P.S. to 7.2 M.C. Accuracy plus minus 5% full scale. 7 peak-to-peak Ranges 0-4 to 0-400. Resistance 7 ranges — measures .1 ohms to 1000 megohms with internal battery. Size — 7 3/8in x 4 11/16in x 4 1/8in. Weight 7lb.
PRICE £27/10/ plus 12½% S.T. Post. Vic., 3/9; Int. 8/4. Easy Terms — £6/18/9 deposit and 45/ monthly for 12 months.

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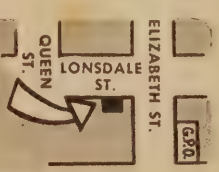

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TRADE REVIEWS AND RELEASES

TELEVISION KITSET FROM "Q-PLUS"

Pictured at the right is a television receiver built up from a complete kit of components currently being marketed by Messre. R. W. Steane & Co. Pty. Ltd. It is classed as a 14-inch portable but can be amended to take a 17-inch tube.

THE makers are well known in the television field for their I.F. strips, and turret tuners, peaking inductors and deflection components.

The receiver illustrated here was developed, both as a guide to the use of these components, and as a marketable item in its own right. It is being made available primarily as a kit for individual homebuilders but can be supplied by special arrangement to small-scale TV manufacturers.

Following common practice, most of the components are mounted on a vertical chassis, with the valves and I.F. cans to the rear and all small components between the chassis and the picture-tube glass.

The circuit is highly simplified to minimise cost and complexity, using 14 valves in all, plus two germanium rectifiers.

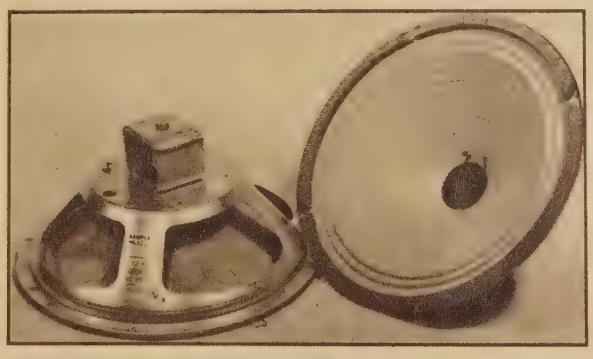
As supplied, the kit includes a standard Mark V IF strip, ready wired and aligned, together with a complete turret tuner, matched and aligned to the particular strip. No further alignment should be necessary after assembly.

The cabinet supplied is made from wood and is available with either blue or tan PVC covering, as required. Safety glass and a simple mask are also provided.

On test, the receiver showed excellent sensitivity, picture and sound being available in an average area on all channels with the aerial connection merely held in the fingers. Good sensitivity is obviously important in a .portable receiver. In other respects, the characteristics were commensurate with an economy portable design, definition, etc., being similar to comparable commercial receivers.

Price of the complete kit is quoted at 99 guineas. For those seeking more detail, a copy of the construction manual is available separately for 11/6, which can subsequently be deducted from the price of the kit, if purchased.

EFFICIENT LOW-COST SPEAKERS



Two loudspeakers currently being sold by Manufacturers' Special Products should be of interest to readers interested in medium - powered P.A. installations or not-too-expensive multiple speaker installations.

Both loudspeakers carry the basic type number 12PR/15 but differ in the nature of the cone.

In one case the bass resonance is 55cps and the response is deliberately tapered above 3500cps. This speaker is intended as a woofer and is normally used in conjunction with the MSP 6-inch tweeter type 20766/6PQ/15.

The second speaker has a 67-cycle bass resonance and a nominal response to 6500cps.

PRICE REDUCTION

The 12PR/15 type actually employs a similar housing and cone to the earlier and well known 12PQ/15. However, it uses a smaller and cheaper magnet which allows a substantial reduction in price. Retail price of the 12PR is quoted as £4/17/11, as compared with £7/18/4 for the 12PQ.

Due to modifications of the magnetic circuit, the sacrifice in efficiency is quite small, and the 12PR/15 is rated to handle 15 watts.

"NATIONAL" TRANSFORMER KIT

The transformers pictured below are currently being marketed by National, for use in the .10-watt Stereo Amplifier described in our December, 1959, issue.

Designated as National type U190/130 VD, the power transformer retails for £5/0/6, including tax. The output transformers type KAD8000/15UL retail for £6/9/9 each. These latter are interwound, on a high grade silicon steel core. Twin secondary windings permit a match to either 3.75 or 15 ohms, in each case with a high percentage of feedback and with very wide frequency response.

Production samples of the kit were tested in our laboratory when the original amplifier was under development and the performance in all respects was excellent. Frequency response, power handling and square-wave performance were up to accepted high quality commercial standards.

Finish of the transformers is in grey stoving enamel.

A 1-henry television choke, which is necessary for completion of the amplifier in question, is also available from National. Though not pictured above, it could be regarded as part of the complete kit.

TANDBERG tape recorder extraordinary

People who know about tape recorders will already know about TANDBERG — the tape recorder extraordinary which puts so many of the best features and so much performance into a neat 22lb package. The latest TANDBERG machine, the 3-speed, 4-track Model 5 Stereo, has the same features, appearance and performance as the still current Model 3BF and is also the first 4-track stereo machine on the market.

Winning features of the TANDBERG have always been the compactness, reliability, ease of operation and "studio-machine" performance.

All models have the traditional polished walnut surrounds measuring 15in long, 11 5/8in wide, 6 5/8in high, and each is contained in a pigskin carrying case from which the top can be completely removed.

Wow and flutter are below 0.1 p.c. at 7½in per second. Frequency response for all models is: 70-5,000 c/s at 1 7/8; 40-10,000 c/s at 3¾; 30-16,000 c/s at a speed of 7½.

RANGE AND QUALITY

For dictation, or when a long, uninterrupted playing time is more important than maximum high frequency response, a tape speed of 1 7/8 i.p.s. will give virtually perfect reproduction of speech. Music lacks only the brilliance obtainable at higher speeds, but there is no audible wow or flutter.

At 3¾ i.p.s. music is recorded with quality and presence never before attained at this speed.

At 7½ i.p.s. TANDBERG gives the truest high-frequency full range sound so far attained only with big studio machines at a speed of 15in per second.

Frequency response at all speeds is given as plus or minus 2db. and the signal to noise ratio is 55 db. below highest recording level.

GOOD DESIGN

The mechanical operation is controlled by a single gear-shift type knob at the right. For recording or play-back the knob is pulled forward; for rewind it is pushed to the left; for fast forward to the right. A mechanical interlock prevents accidental erasure.

Starting and stopping is smooth with no spillage of tape, and instantaneous starting can be obtained by pulling the knob forward slightly to start the motor before engaging the idler wheel against the highly polished capstan.

A speed control knob at the top between the reels selects the desired speed and changes tape equalisation at the same time.

Just above this switch is the speaker control which connects the internal speaker to either of the two channels in the case of stereo or disconnects it entirely.

To the left of the lower head cover is the main function control switch with positions for record, playback and public address. In the latter position the microphone is fed directly through the amplifiers and speakers.

The volume control knobs are dual in the stereo machines with a friction clutch causing both to turn at once in normal use, but balancing can be done by displacing one with respect to the other.

Under this dual knob is a lever which selects the mode of operation—stereo or mono tracks 1-4, or mono tracks 2-3. The level indicator eye is just above the volume controls and to the left is a bass-lift switch which increases lows by 12db. at 70 c.p.s. A unique time indicator accurately locates any part of the recording.

All inputs and outputs except the microphone, which plugs into a jack on the top panel, are available at a terminal panel at the rear. A small compartment is provided for the power cord.

STEREO RECORDING

Apart from producing a marvel of compact design, TANDBERG are obviously setting the pace in terms of tape recording technique.

The 3-speed, twin-track Model 3 sets the standard of TANDBERG design and performance which remains unchanged and unmatched. It also incorporates an electrically operated foot-control.

The advent of 4-track stereo tape has tended to supersede the Model 3 with the 3-speed, 4-track Model 5 which also has the foot-control. In this model the second stereo channel is fed into a pre-amplifier of 0.5 Vo high impedance output for feeding in an existing power amplifier.

The new Model 5 Stereo carries the process one step further. A power output stage is included for each stereo channel. The addition of two high quality loudspeakers is all that is necessary for playing back either 2-track or 4-track stereo tapes.

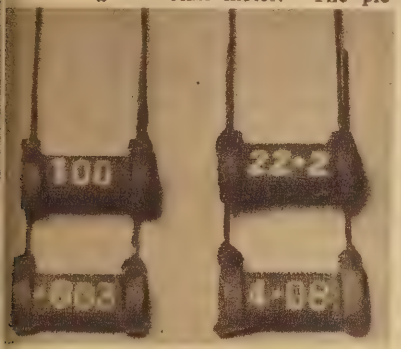
Finally, a Stereo Record Amplifier measuring 8¾in long, 2¼in wide and 5¼in high, is available for Models 3 and 5 to enable high quality stereo recordings to be made.

TANDBERG tape recorders are distributed throughout Australia by **Simon Gray Pty. Ltd.**, of Melbourne, and are available through the leading retailers.

JABEL SHUNTS FOR PROTECTED METER

Those readers interested in constructing the Fully Protected Multimeter (January 1960) will be interested to know that shunts required for this instrument are now available in kit form.

THESE are to be marketed under the Jabel brand and a complete kit consists of a close tolerance 100 ohm resistor for use in series with the meter, and three shunts to provide the 250 mA,50 mA and 10 mA, ranges on the basis of a 200 ohm meter. The pic-



ture shows the complete kit with actual resistance values clearly marked on each unit.

All four resistors are wound on standard "3-watt' type ceramic formers and finished with a tough protective coating. A sample kit submitted to us proved to well within the tolerance claimed for them and were, in fact, used as a basis for our experiments described in the January issue.

Further details, price etc., may be obtained from the distributors, Watkin Wynne Pty. Ltd., 21 Falcon Street, Crow's Nest, N.S.W.

JACOBY MITCHELL A PUBLIC COMPANY

Jacoby Mitchell Holdings Ltd. has acquired all the shares in Jacoby, Mitchell and Co. Pty. Ltd. and associated companies.

THE holding company which has a paid up capital of £120,000 plus £30,000 in registered unsecured convertible notes, will seek listing on the Sydney Stock Exchange. On a public company basis, profits over the last three years average 18.56 per cent with 1958-59 profits showing 21.85 per cent.

The company expects to pay dividends at the rate of 12½ per cent.

In order to obtain Stock Exchange listing, a share placement has been made through a Sydney share broker, at 6/10 for each 5/ share.

The directors of the Holding company are the same as of the main operating company, Jacoby, Mitchel and Company Pty. Ltd. Mr P. H. W. Jacoby is Chairman and Managing Director. The company is prominent in the electronics field concentrating on equipment for research and industry.

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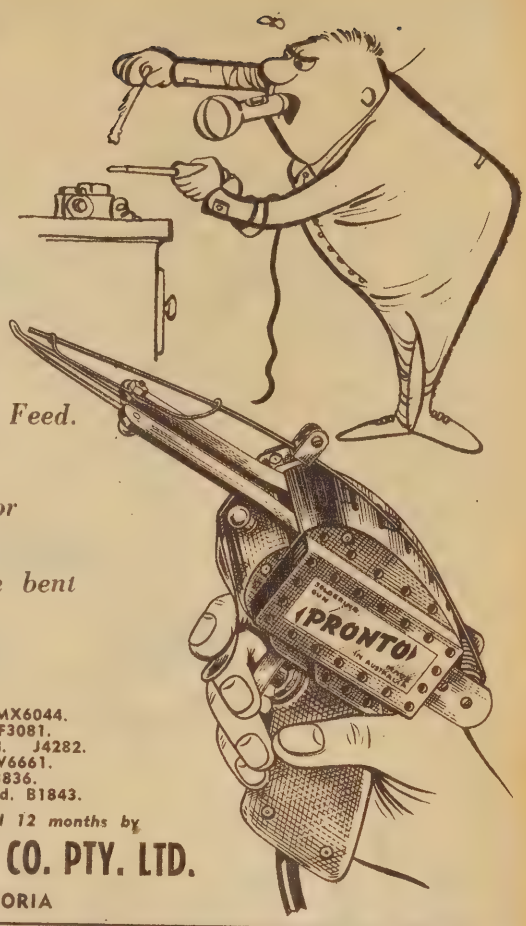

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Let's Buy An Argument

I imagine that a subject which will be hotly argued in the next few months will be the desirability or otherwise of using a centre speaker with a stereo system to create a synthetic third channel. Further, how such a signal should be derived.

by Neville Williams

IN his "Off The Record" notes in the last issue, Editor John Moyle cast heavy doubt on the necessity for a third speaker, pointing out that, by suitably arranging his stereo pair, he has no "hole in the middle" needing to be filled.

It is possible however, that a centre speaker will emerge as desirable practice where an optimum layout cannot be achieved or where it is desired to cater for a larger proportionate listening audience. Of the compromises which must come from such conditions, the centre speaker idea may have something to recommend it.

NOVEMBER ISSUE

However, it is not my intention just here to enlarge upon this aspect but rather to follow up — or let a correspondent follow up — a reference in the November issue.

If a centre speaker is desirable — and I emphasise the "if" — how should the signal for it be derived?

One may conceivably use a third amplifier and feed it with a composite signal derived by "mixing" suitable proportions of the low-level stereo signals. But this involves a complete third amplifier, adding to first cost and subsequent maintenance.

The alternative is to derive a signal from the output circuits of the two stereo amplifiers, applying it directly to the voice coil of the centre speaker. This obviates the need for a third amplifier but it does raise problems relating to the phase of the derived signal, the power level in the centre speaker relative to the original stereo pair and the influence of the extra speaker on the load presented to the two amplifiers.

An article in our August 1959 issue, by Donald C. Hoefler, discussed the general proposition of hooking in the third speaker without giving proper attention, in the opinion of some of our readers, to the problems just mentioned. Hence the correspondence and other reference in the November issue which prompted the letter reproduced opposite, from M.K., Marryatville, S.A.

Ideally this should have followed in the December issue but our printing schedule and the intervention of other material have held it up.

However, as I said earlier, I expect that this whole subject will be one for argument for a long time to come.

OTHER REFERENCES

Already a good deal of discussion about it has appeared in overseas magazines, some of it along similar lines to what has been said by our correspondent, M.K., though with much less concern about matching problems and proper sharing of acoustic power.

There is, however, fairly common agreement that any third channel must be supplied with an additive signal. This means that the centre speaker will receive maximum power when the two outer speakers are in phase. This is presumably the condition which obtains when the original sound source is equidistant from the microphones and it is appropriate that the centre speaker should then receive the maximum allotted power.

The necessary circuit conditions are achieved by earthing the centre tap of the voice coil secondary windings in the two amplifiers, rather than one side, as has been usual practice. The feedback components are modified, as necessary, to achieve the right order of gain reduction and compensation.

The main left and right speakers are operated as normal from the whole windings, the leads being connected to produce the right relative phase between them. The centre speaker can be strung between one end of one winding and one end of the other, selected to produce the additive output required.

C.T. SECONDARIES

There is no great problem in all this provided, as often, the output transformers have centre-tapped secondaries, designed for alternative operation with 3.75 and 15-ohm loads.

Our correspondent, in the letter opposite, has assumed multi-tapped secondary windings, earthed at an intermediate point but otherwise connected to meet his idea of optimum matching.

I suggest you read what he has to say.

From a reader in New Zealand comes another letter on the subject of stereo and reading as follows:

"I would like to add my comments

(Continued on page 75)

MATCHING THIRD-SPEAKER IN STEREO SYSTEM

A Letter to the Technical Editor:—

Dear Sir,

In the November issue last (with reference to Mr Hoefler's article), you questioned the possibility of matching a speaker to two channels carrying different signals. I suggest that this is possible in so far as a speaker can be considered as a pure resistance.

To do this, the circuit must be arranged so that, when the speaker receives no power, because of the phase relations in the two channels, power is dissipated elsewhere in the system.

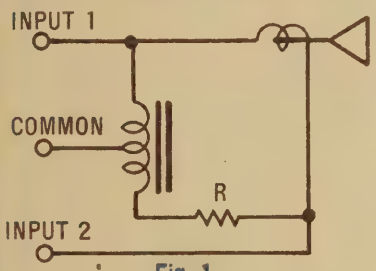


Fig. 1

I would suggest the circuit as in figure 1.

The resistance R is to be equal to the speaker impedance. The load reflected into each channel is then approximately R/2 for any phase relation in the two-channels, assuming each amplifier to have very low output impedance.

Having suggested a method by which match may be obtained I would go further and suggest that it is rather pointless to obtain this match when we recognise the reason for matching speakers to amplifiers.

As you said in your article, the speaker does not normally work from a source of equal impedance but from a source of much lower impedance.

The correct load impedance for an amplifier is that impedance into which the amplifier will deliver a maximum output without exceeding a given relative distortion level, irrespective of the input level to the amplifier required to produce this output.

Equal impedance matching, on the other hand, gives maximum output from the amplifier for a given input signal level, provided this is kept sufficiently low so as not to overload the amplifier.

The important point is that, provided the amplifier output impedance is much less than the load impedance, then the voltage output from the amplifier is constant for variations in load impedance.

Overload, then, only occurs for given input if too much current is drawn from the amplifier; that is if too small a load is connected.

Distortion will not be increased by increasing the load impedance for a given input signal, but may be slightly reduced. At the same time the power output will be reduced to a greater extent than the distortion; power output will be inversely proportional to the load resistance.

Thus if we, say, double the output impedance, we halve the output power for a given signal level and slightly decrease the relative distortion or, if we make the load impedance infinite, we decrease the output power to zero and obtain a further slight reduction in relative distortion.

Applying this to figure 1 we see that, by removing the resistance R, we do not affect the power dissipated in the speaker, so that we obtain the same useful acoustic output. We do, however, decrease the total output except when the two input channels are 180 degrees out of phase.

This extra output was previously dissipated in the resistance R.

At the same time removal of the resistance R can only increase the load impedance reflected to the amplifier so that, for a given amount of power dissipated in the speaker, there is no increase in distortion on removal of the resistance.

Thus there is little point in re-

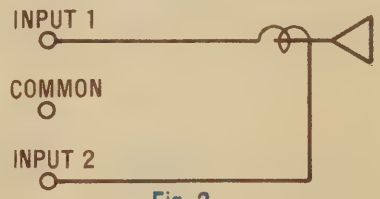


Fig. 2

taining this resistance, and the speaker can be considered as matched (dissipating a maximum of power for a given amount of relative distortion under the most unfavourable phase relations in the two channels). Removal of the resistor makes the auto-transformer unnecessary so that the circuit becomes as in figure 2.

This discussion has ignored the two main channel speakers but these will not affect the essentials of the argument. To obtain optimum match it is only necessary to ensure that each amplifier looks into its nominal load with its main speaker and the centre speaker network connected, where the centre speaker network is considered as reflecting an impedance equal to half its speaker impedance.

This makes it rather difficult to match to standard output transformer tappings but 8 ohm and 2 ohm taps used as follows would probably be a reasonable compromise (see figure 3).

Mr Hoefler's diagram suggests, although it does not specifically

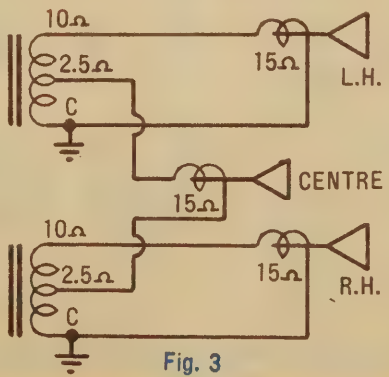


Fig. 3

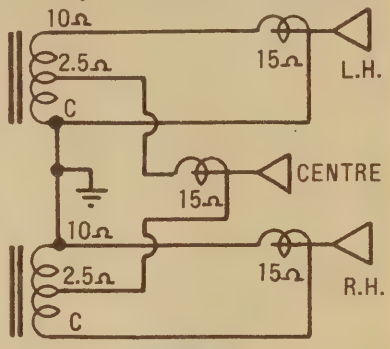
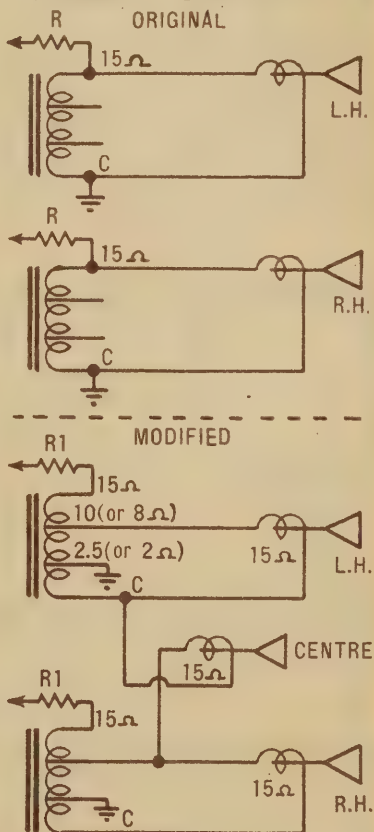


Fig. 4

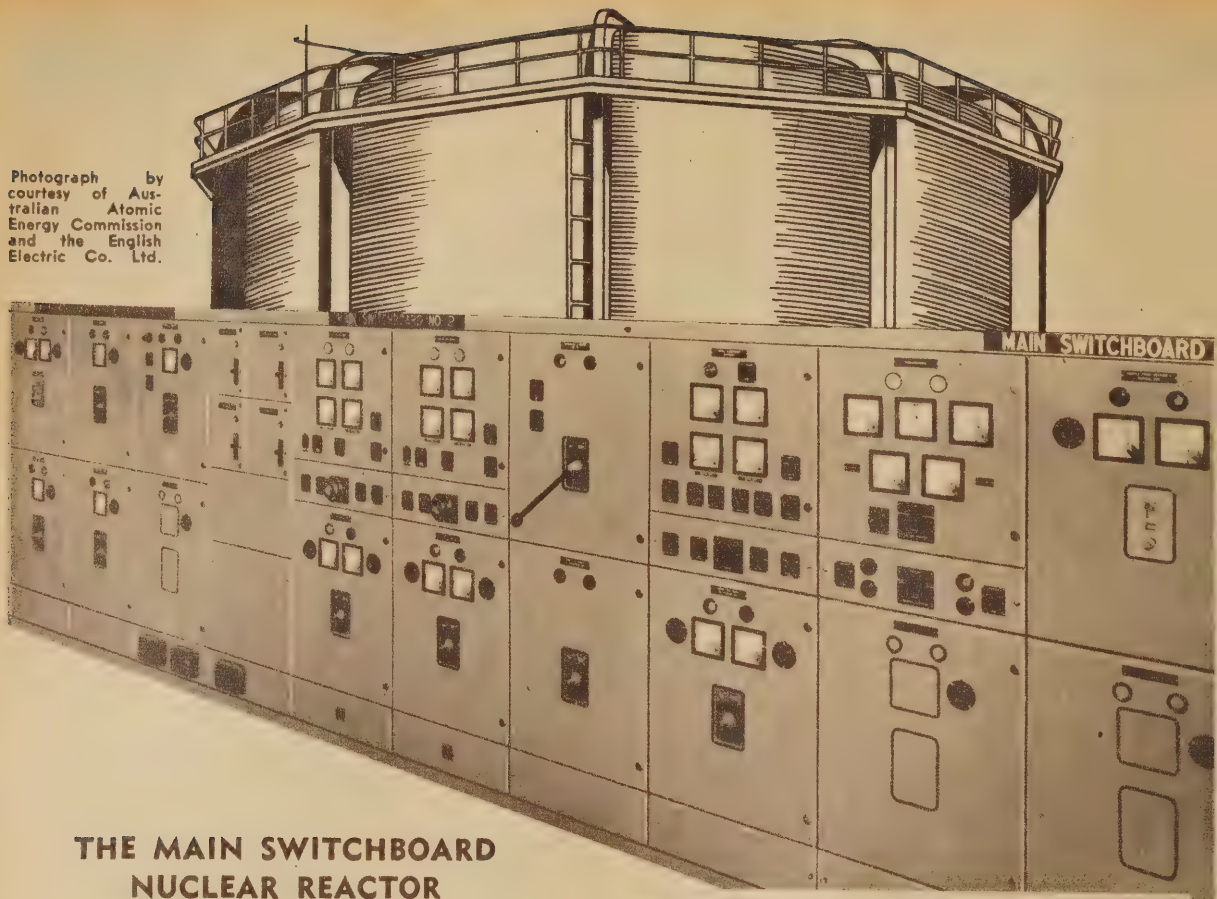
show it, that the centre speaker receives a voltage proportional to the difference in the two channels. It therefore delivers no output when the main channel speakers are working in phase and it works in

(Continued in panel overleaf)



For 2.5Ω taps earthed, R1=.59R.
For 2Ω taps earthed, R1=.64R.

Fig. 5



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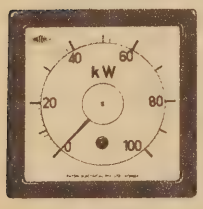

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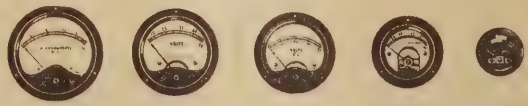

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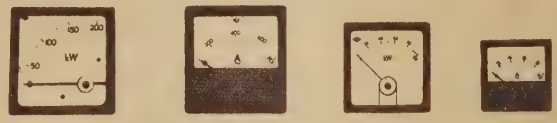

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SWITCHCRAFT, LOGIC AND PLAIN COMMON SENSE

A REPLY BY R. HARTKOPF

I READ with interest and appreciation the comments of Mr V. Molesworth on my "Switchcraft" article in the November issue of "R.TV. and H." His insistence, however, on logic first, last and always, rather reminds me of a story . . .

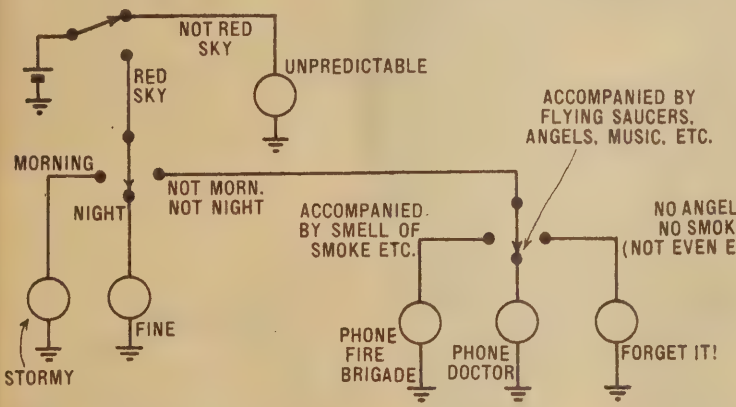
There was once a man who had a cat. To give it free access to the house he cut a hole in the back door. When the cat had kittens the man, who was a very economical and logical person, could not bear to see the large hole being wasted on such tiny kittens, so he cut a second, small hole in the door especially for them. Which goes to show that logic and common sense are not always quite the same thing.

Getting back to the weather predictor, I think we all agree that the premises supplied are that a red sky in the morning indicates stormy weather and a red sky at night indicates fine weather. Morning and night, of course, are used for the sake of the rhyme; what is meant in the verse is the period around about sunrise and the period round about sunset.

It is true that within the limitations of the rhyme one can only have a red sky and fine or stormy weather. But let us (unlike the man with the cats) add a little common sense to our foundations. Obviously the sky can be red or not red. Again common sense tells us that we have no information as to what happens to the weather when the sky is not red and therefore as far as the verse and the gadget are concerned the weather is unpredictable. If the sky IS red then the weather is predictable for both morning and night conditions.

Mr Molesworth is, I think, prepared to grant all this, but goes on to say that if "not red sky" is included as an alternative to "red sky" I should have included "neither morning nor night" as an alternative to "morning" and to "night." Now really!! Shades of Aristotle and the man with the cats!!

As a citizen of Melbourne, I realise there are uncivilised areas to the north where anything can happen and perhaps a red sky at midday up there means that someone has let the camp fire go out and the tea is cold. Or perhaps a red sky suddenly cropping up in the middle of the morning or afternoon may even have something to do with weather. Not being acquainted with these foreign parts, I wouldn't know. In civilised places we just don't normally get red skies popping up at odd hours of the day and night. Therefore, if one MUST have a "neither morning nor night" switching position I can only suggest the circuit above. The fact that the gadget now becomes a fire warning device and a hallucination meter as well as a weather predictor is sad but inevitable. Further developments re green skies on New Year's Eve, blue moons on Guy Fawkes night and similar phenomena I will leave to Mr Molesworth.



THIRD LOUDSPEAKER

(Continued from Page 73)

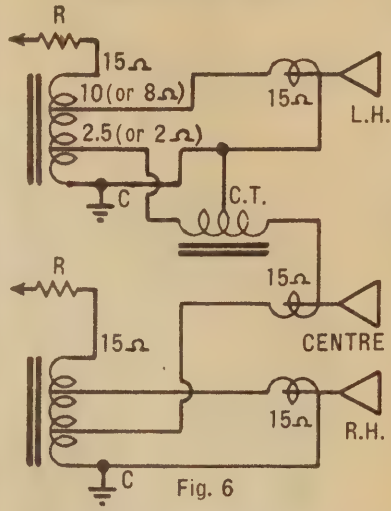


Fig. 6

phase with one and out of phase with the other channel speaker when these speakers are working out of phase. The arrangement is therefore not symmetrical and therefore, I feel, undesirable.

I would suggest that the centre speaker be fed with a signal proportional to the sum of the signals in the two channels. If there are no feedback connections to the secondaries of the output transformers speaker-connections may be arranged as in figure 4.

If feedback connections are made to the secondaries it may be possible to adjust the feedback resistors and alter the connections to those shown in figure 5.

Alternately an auto-transformer may be employed as in figure 6.

In each case, when all three speakers are working in phase, they receive equal amounts of power.

Yours faithfully, M.J.K.

---

o those of G.G. and D.W.N. concern-ng your article 'What To Do About Stereo Speakers.'

"For a start, I do not agree with G.G. vhere he says 'We can say that when here is no phase or loudness difference etween sounds arriving at the two ears, here can be no directional effect.'

"This can be easily disproved by plac-ng a monaural record, preferably of iano or other solo instrument on a good ouble woofer stereo outfit.

"With the balance control set for qual sound from each set of speakers, he instrument definitely appears to come from the centre, halfway between the two speakers. And yet there is no phase or loudness difference between each channel; how can there be, with a monaural record played with a monaural pickup?

APPEARS TO MOVE

"But if the balance control is altered, the piano appears to move towards the speakers from which most sound is coming.

"All this goes to show that, at frequencies below 300 cycles, although there is no noticeable phase difference, there can still easily be a loudness difference between channels and therefore position the sound just as clearly as at higher frequencies, where phase difference comes into play.

"With a single woofer double-tweeter system, a string bass would sound like a guitar at one side of the room and some deep, unrealistic bass instrument in the centre—that is if the string bass is on one side, as it is on Louis Armstrong tracks of the Glenn Miller Story.

"Only with two entirely separate speaker systems is it possible to obtain real stereo. "Yours sincerely, M.D."

(Continued on Page 81)

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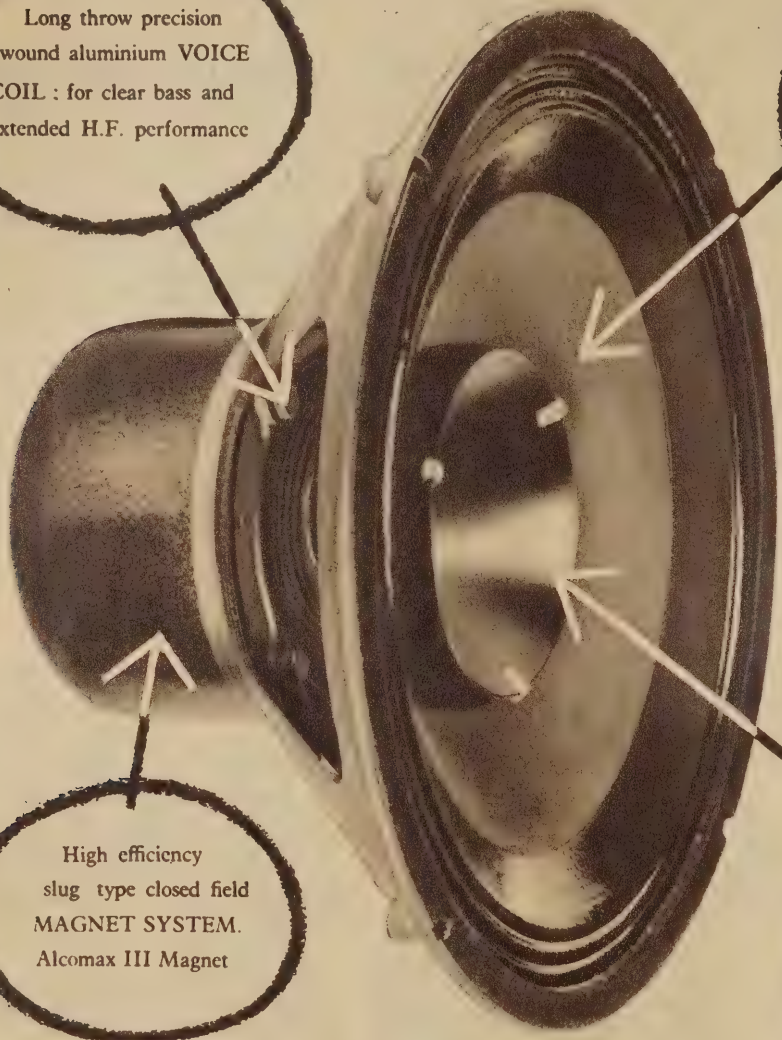

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MORE ABOUT "ELECTRIC BRAINS"

Prompted by the interest which readers have shown in "Logic machines," Mr. Molesworth has written this follow-up to his article in the last issue. While few may actually want to build the more complicated devices, many will doubtless be interested in the thinking behind them.

By Vol Molesworth, M.A.

OUR first "electrical brain," described in the February, 1960, issue of this magazine, was a machine designed to reason infallibly in a certain form.

The form in which it carried out its reasoning functions was the first figure of syllogism.

To use the machine, we fed in pieces of information in a certain form and order, and these were woven together by the machine to produce a new piece of information, the absolutely irrefutable conclusion of the reasoning process.

For example, were we to feed in the data that all women are beautiful, and that every wife is a woman, the machine would produce the conclusion that every wife is beautiful. It would do this by cancelling out the middle term, "women," which is common to both premises.

Leaving aside the particular content of the argument (with which some churlish knave may wish to disagree) the form of this first figure syllogism is

All M are Y
All X are M

All X are Y

The middle term occurs as subject of the major premise, and as predicate of the minor premise. This is the characteristic form of a Figure 1 syllogism.

There are, however, other possible forms of reasoning. The middle term could be subject of both premises, predicate of both premises, or subject of the minor and predicate of the major.

The possibilities are:

Fig. I	Fig. II
M — Y	Y — M
X — M	X — M
X — Y	X — Y
Fig. III	**Fig. IV**
M — Y	Y — M
M — X	M — X
X — Y	X — Y

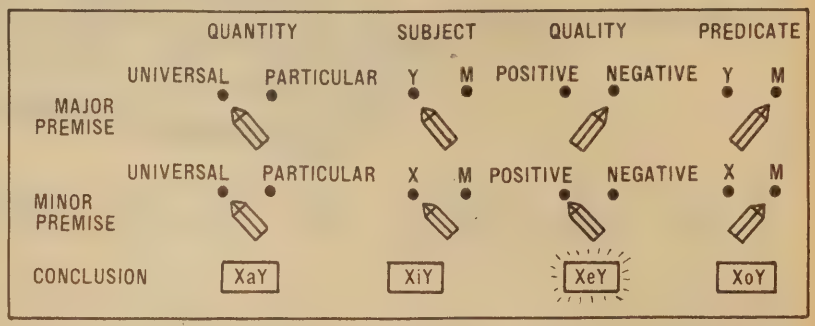
An example of a valid syllogism in Figure II, for instance, would be:

No saints are cruel
All criminals are cruel

No criminals are saints.

Aristotle, the founder of logic as a science, regarded the first figure of syllogism as the model of all reasoning, and he demonstrated that syllogisms in the other figures could be reduced to Figure I syllogisms.

But there is no logical reason why we should so reduce them. We do reason in the other figures, and we should therefore include such reasoning functions in the circuit of our electrical brain.



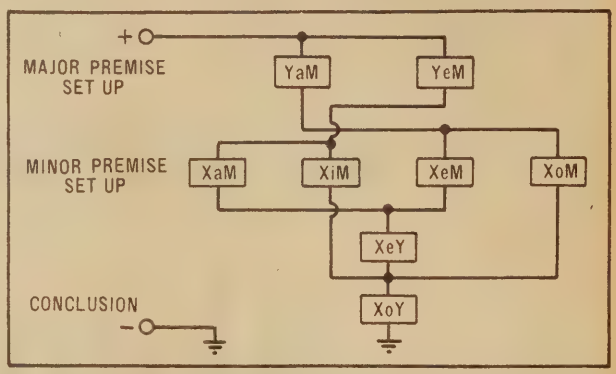


Diagram A, above, is a possible panel layout for the extended "electrical brain." Diagram B, right, shows the operations for a Figure II syllogism.

Our extended machine would then be able not only to handle reasoning processes in each of the four figures of syllogism, but would allow us to feed in information in a wide variety of forms.

We may be given the information, for example, that all radio experimenters are spendthrifts. We know that no misers are spendthrifts, and we wish to find out what follows from the piece of information and the acknowledged fact.

We cannot fit these premises into a Figure I syllogism, but they can be fed straight into the inputs of our new brain to produce the following piece of reasoning:

No misers are spendthrifts
All radiomen are spendthrifts

No radiomen are misers

(They may be magpies, but that's not the same.)

Remembering that it is possible to vary both the quantity (universal or particular) and the quality (affirmative or negative) of each of our premises, we would need to design a new control panel as illustrated in diagram A.

In this illustration, we have set up the premises of the reasoning process concerning the relationship of radiomen and misers.

To get the first premise, we ask what is the subject of our known fact. The answer is "misers," and the point is that none of them are spendthrifts. We therefore select the universal quantifier and the negative qualifier (which is equivalent to "none . . . are") and set up Y (for "misers") as our subject, and M (for "spendthrifts") as our predicate. We always use "M" for the middle term.

THE INFORMATION

Now for the piece of information. The subject is "radiomen." All of them? Certainly! Our informant has offered no exceptions. And his description is quite positive—they are spendthrifts. So we set up X (for "radiomen") as our subject, and M again as our predicate. We turn the quantity switch to universal and the quality switch to positive ("all . . . are").

The instant we do this, the electrical brain flashes on a globe which lights up the panel labelled "XeY," which is translated into everyday language as "No radiomen are misers."

Suppose, at this stage, somebody wanders into the shack and raises the objection that, in his opinion, some radiomen ARE misers.

We can quickly couple this with the premise not in dispute (the acknowledged fact), and see what follows:—

No misers are spendthrifts.
Some radiomen are misers.

Some radiomen are not spendthrifts.

This provides us with a direct contradiction of the information given to us earlier.

We see now the principal advantage of our extended electrical brain. It may

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take a little longer to set up the premises —eight switches to adjust instead of four in our earlier model—but its very flexibility enables us, in a few seconds, to try this possibility or that—to try, in fact, endless possibilities, endless arrangements of data, and see what logically follows.

It allows us to exploit every avenue of "what if?" and "if—then." It will produce no conclusion at all if the premises we select are not fruitful—the "don't be silly" or "dead end, chum," function.

We have already seen how a Figure 1 syllogism-making machine can operate ("R, T & H," Feb., 1960).

Figure II would operate as in diagram B.

When we set up YaM (All Y are M) as our major premise, positive voltage is applied to both XeM (No X are M) and XoM (Some X are not M).

No matter what other minor premise we set up, in this figure of syllogism, no conclusion can follow.

But the moment we select XoM, current flows through that channel and goes to earth through the conclusion panel-light XoY (Some X are not Y).

There are various ways in which we could cause the appropriate channels to conduct in order to provide valid reasoning processes. One method would be to use electronic valves with sufficient initial bias to place them beyond cutoff, and then remove enough of the bias to allow plate current to flow. (This would make it a genuine ELECTRONIC brain, too.) Or we could be really mod'n, and use transistors.

But the principles of operation can be more simply illustrated using ordinary electrical switches, relays and panel lights, together with a source of direct current. We are, after all, still in the T-model stage of our designing, and the use of switches will be in keeping with the article which inspired this series ("Switchcraft," this journal, November, 1959).

Since we are proposing to handle information (or "process data," to use the jargon) in whatever manner it is supplied to us, reserving only the right to reformulate it in the unambiguous logical form of the appropriate proposition, and since we are proposing to reason in each of the four figures of syllogism, there will be a large number of internal switching alternatives.

We can tackle the design problem by making a list of the fruitful major and minor premises and the valid conclusions possible in each figure of syllogism.

Since the world is complex, and the mind which reasons about the world (and about itself, as part of existence), is also complex, the list is impressive. (See diagram C.)

The list is formidable, but we can reduce it greatly by eliminating duplications. Leaving aside considerations of figure, the required premises and conclusions are as in diagram D.

For our extended brain, then, we need only seven channels for our major premises, seven channels for the minor premises, and four panel lights for our conclusions.

Since the ONLY criterion on which the machine operates is reasonableness, there is no point in hooking up any combination of premises which does not produce reasonable answers.

The first section of the extended brain to be wired up is that which sets up the major premise. (See diagram E.)

The DC voltage is applied first to the "Subject" selector switch. Since X can never appear in the major premise, the switch applies the voltage to either Y or M.

MAJOR & MINOR PREMISES LIST

FIGURE	I		II		III		IV	
Major premises	MaY	MeY	YaM	YeM	MaY MiY	MeY MoY	YaM	YeM YiM
Minor premises	XaM	XiM	XaM XiM	XeM XoM	MaX	MiX	MaX	MeX MiX
Conclusions	XaY XiY	XeY XoY	XeY	XoY	XiY	XoY	XeY	XiY XoY

Diagram C.

MAJOR	MaY	MeY	YaM	YeM	MiY	MoY	YiM
MINOR	XaM	XiM	XeM	XoM	MaX	MiX	MeX
CONCLUSIONS		XaY	XiY	XeY	XoY		

Diagram D.

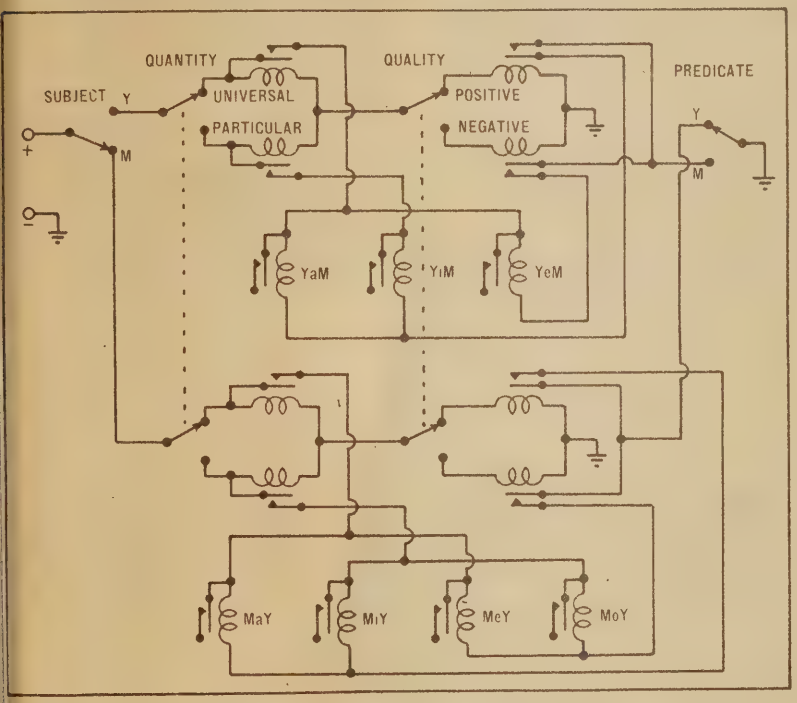

Diagram E: This diagram illustrates the first section of the electrical brain, used to set up the major premise.

QUANTITY, QUALITY

After passing through two double-pole double-throw switches, which select first the quantity and secondly the quality of the major premise the current is earthed through the Predicate selector switch, which selects either Y or M as the predicate.

Either the Y-M or M-Y path is activated, but current cannot flow when we set up either Y-Y or M-M. This is because a premise such as "All Y are Y" or "All M are M" tells us nothing, and premises such as "No Y are Y" or "Some M are not M" are self-contradictory.

Notice that there is no major premise relay-possibility for YoM. The rules of inference do not allow any valid conclusion to follow when it is used as a major premise, so we simply omit it.

When the major premise is set up, current will flow through the relay representing that major premise. The field will close the contacts associated with that relay. It is through those contacts that the current (the line of thought) travels to the relays representing the minor premises.

The minor premise selector is wired up in exactly the same way as the major premise selector, except that instead of selecting either Y or M as the subject and earthing the alternative, we must now select X or M and earth the alternative.

We would need to be able to set up the X-M premise in each of the four forms (XaM, XiM, XeM and XoM), but since MoX can never be a fruitful minor premise, the M-X section energises only three relays (designated MaX, MiX and MeX).

There is no point in drawing out the

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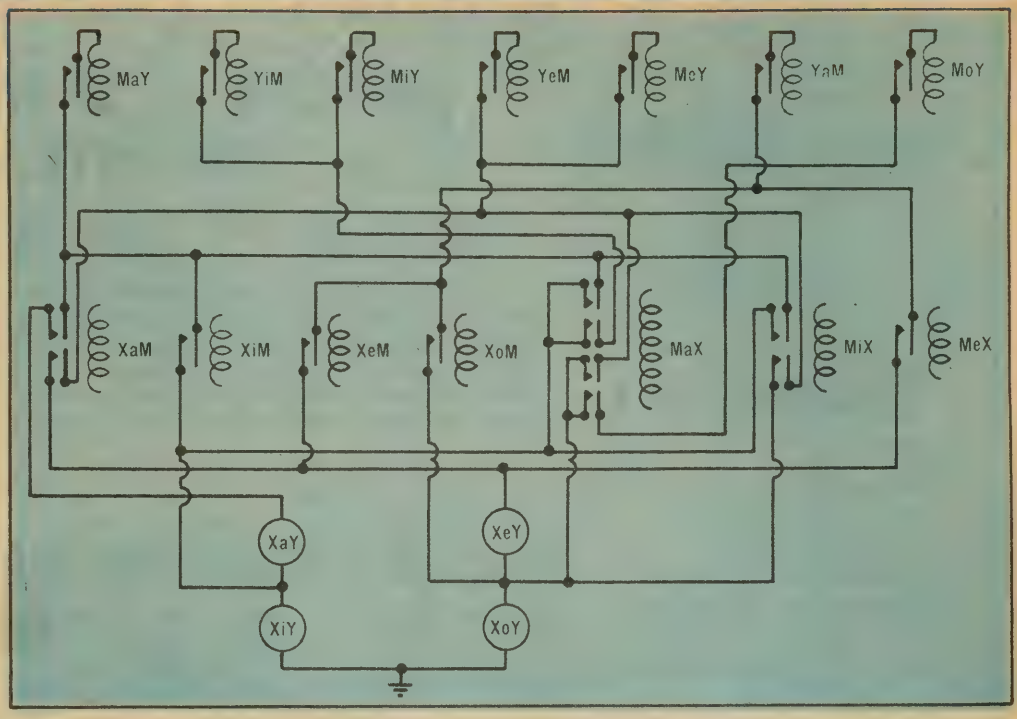


Diagram F: The extended version of the "electrical brain." Try it on the wife, the author suggests—if you're game!

☆

ircuit, because it essentially the ame as that for ne major prem-es, with different abels attached to ne various relays. We can now ook the two ses-ions together into ne extended brain. Diagram F.)

The extended rain employs a otal of 30 relays nd four illumin-ted panels, but in o reasoning pro-ess will more han six relays and ne panel light ver draw current.

With the relays mounted in several anks, the complete "brain" can be oused in a small carrying case.

The extended brain is not a party immick, though it would certainly pro-ide plenty of entertainment. It has more nportant uses.

It can be used to discover the logical onclusions of data fed into it, to check ne's own reasoning processes, to test ypotheses, and to determine on what rounds a given belief is based.

RY IT IN KITCHEN!

It can be taken into the kitchen and sed to demonstrate the unsoundness of he wife's ideas. (When used for this urpose, it should be built in a sturdy ase to withstand heavy knocks.)

The machine can be used in schools nd universities to demonstrate the basic rinciples of reasoning.

The next step would be to build in n artificial "memory" in which the achine could store whatever informa-on was fed into it. Given any major remise, it could then be designed to earch through its memory for appro-riate minor premises and produce a ries of logical conclusions, which could e recorded by teletype or some other eans.

The penultimate step would be to fit e machine with a memory bank of ajor premises, too. It could then play ith endless arrangements of data, ther like a man musing about things general.

The ultimate step would be to provide e brain with TV eyes and microphone rs and let it gather its own data.

We may then be superfluous.

LET'S BUY AN ARGUMENT

(Continued from Page 75)

With all due respect to M.D., I cannot help but feel that he has fallen into a number of traps and, without necessarily seeking to dispute his conclusions, I cannot go along with the processes by which he has reached them.

In the first place, I doubt that he has correctly interpreted the ideas of earlier correspondents. They specifically mention phase and loudness effects and I had not personally gathered the impression that they had minimised the importance of the latter to the extent that M.D. imagines.

Whether or not this be so, M.D.'s basic observation is perfectly true: In a well balanced stereo system, playing a monaural signal, the source of the sound does appear to be a region midway between the actual speakers. As the relative level from the individual speakers is varied, the source appears to shift toward the louder one.

In fact, the ability to produce this effect appears to me as a rather good test for any stereo system and is a more or less automatic indication that the desired acoustic directivity can be obtained without any obvious "hole in the middle."

Unsuitable room layout, a poor listening position or acoustic unbalance between the speakers would all conspire to make the effect difficult of achievement, and certainly make for poor stereo as an end result.

But, to my mind, M.D. has erred in accepting this as proof positive that the effect depends on loudness of signal AT ALL FREQUENCIES and that it can therefore be achieved only with a completely balanced pair of stereo speakers.

Even though the nominal pitch of perhaps the bulk of the musical sounds may be below, say 300 cps, it has already been pointed out that all these sounds would normally be accompanied by overtones and there is reason to believe that these overtones are the key to our judgment of direction, relative to the low frequency register.

GREAT DIFFICULTY

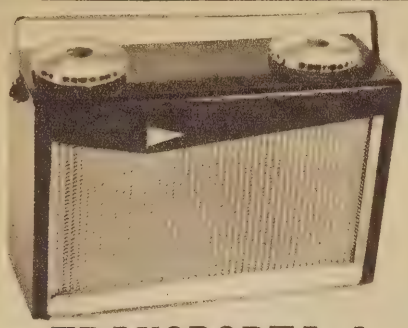
It is further claimed that there is the greatest difficulty in judging the source of low frequency energy as such, and especially within the angular dimensions involved by an ordinary stereo system. This, in spite of anticipated phase or level differences.

If all this is true—and it is widely held to be so—the idea of overtones emerging from one speaker while the relevant lower frequency components plainly emerge from somewhere else, is quite wrong.

The ear merely registers a certain familiar overall sound. It judges the sound as coming from a particular direction by reason of the higher frequency overtones. The fact that the lower frequency content comes from somewhere else is not noted, because the ears (allegedly) have no acute sense of direction for these frequencies.

On this assumption depends the whole idea of stereo systems using two higher frequency speakers and one woofer. At this stage, I am not suggesting that the scheme is necessily good, bad or indifferent. I'm merely pointing out to M.D. that his observations, to my mind, do not prove the point he is so anxious to make.

MAKING A TRANSISTOR PORTABLE?



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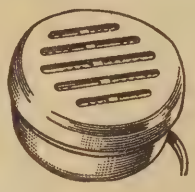

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1T4	4/6	6SH7	5/6	6C8G	5/	7C7	3/6	7193	3/6
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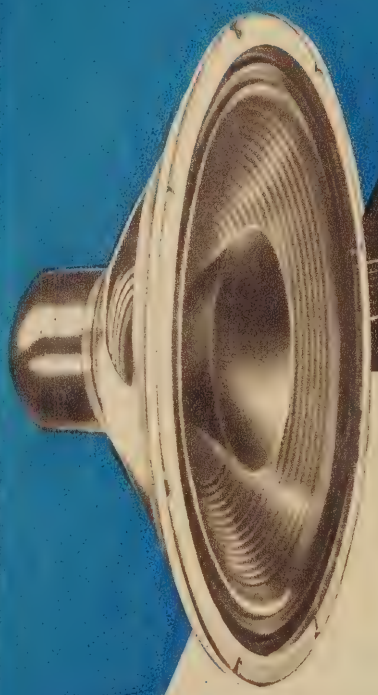

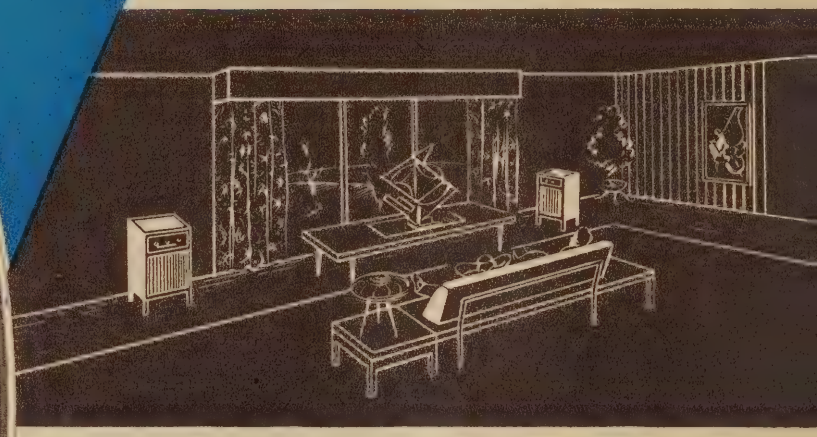

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OFF THE RECORD — NEWS & REVIEWS

Perhaps the most obvious problem about using stereo in the home is the need to provide two speakers and to arrange them in the room relative to the listening area, so that the desired effect will be obtained.

By Neville Williams

THE cases where a pair of speakers fit naturally into a room are probably in the minority. It is more usual to have to replan the listening room, and to put it mildly, this doesn't always meet with automatic domestic approval.

May I offer this brief appraisal of the subject, in the hope that it can be read quietly and objectively by members of any household, which does not see eye to eye.

The first and major question is whether a stereo system is required, or not.

As with any other household amenity, only the individuals concerned can provide the answer, for they must set their own values to the factors involved.

About the poorest reasons I know for putting in stereo are "being up-to-date" and "keeping up with the Jones."

"RECORD PLAYER"

Unless use of the equipment produces an appreciation later of what it has to offer in the way of improved reproduction, the stereo radiogram will remain just "a thing to play records on."

Stereo or mono, what's the difference?

Then, again, some readers of this magazine may need a stereo system for technical and/or commercial reasons. It is part of their job to be informed on modern developments and, by "informed," I don't mean the mere knowledge that certain things are so or that they operate in a certain fashion.

A ready appreciation of what is a good, bad or indifferent record, or piece of equipment or, in this case, good, bad or indifferent stereo, can only be gained by relaxed listening in the home.

Listening, which is confined to "demonstration" or "laboratory" conditions, can be artificial in many ways and lead to an unbalanced assessment of what is or is not important in practice.

BEST REASON

But, over and above this, the best reason for wanting a stereo system is the desire to have what it can offer in the way of musical reproduction. Perhaps it might be better to say . . . the contribution it can make to musical enjoyment.

The seeker on this level has most to gain.

And this leads naturally into the second question: "Is stereo worthwhile or is it just a fad which is doomed to disappear?"

In answering this question, the vital point to appreciate is that stereo has something quite definite to offer; it is founded on sound engineering principles; it is not just a gimmick to sell more records and record players.

The "something" which stereo has to offer is a vital sense of direction. Reproduced sound no longer needs to emerge in toto from a single hole in a baffle or from a number of such holes, related in a purely artificial way to one another.

The second channel contributes much more than just a hole in a second baffle; by the interplay of phase and loudness, two properly related channels and speakers can create a so-called "wall of sound" in which individual sources appear to exist not only adjacent to the speakers but also in the space between them.

It largely restores the normal directive function of the ears, allowing sound to be analysed selectively, just as happens in original listening.

It is quite wrong to consider stereo as an alternative to high fidelity or to argue on the basis of preferring one to the other.

Our concepts of high fidelity have thus far been based on frequency response and distortion. But if the term "high fidelity" is related, as it surely must be, to the achievement of the ultimate in sound reproduction, then it must equally include perspective or directivity.

In other words, multi-channel reproduction is an essential aspect of "high fidelity" in its fuller sense.

To be sure, the stereo system, as we know it, has limitations, just as audio components have limitations in the way of response and distortion. But because stereo has been shown to be practical and because it is an essential part of realism in sound reproduction, it is certain to stay with us; to be refined and developed as time goes by.

To limit any significant audio planning, nowadays, to a purely mono system would, to my mind, be foolish indeed.

Well then, if stereo has to be provided for, in the ultimate, can't it be compacted into a single cabinet, to overcome the problems of space? Why can't stereo be made small and "neat"?

Fundamentally, stereo demands that the outer speakers be separated by a figure which is not too much smaller than the distance to the listener; further that the listener(s) be seated as close as possible to the apex of a symmetrical triangle, of which the line between speakers forms the base.

SPEAKER SEPARATION

In an average home this means a separation between cone centres of not less than 6 feet; in most cases it will need to be rather more.

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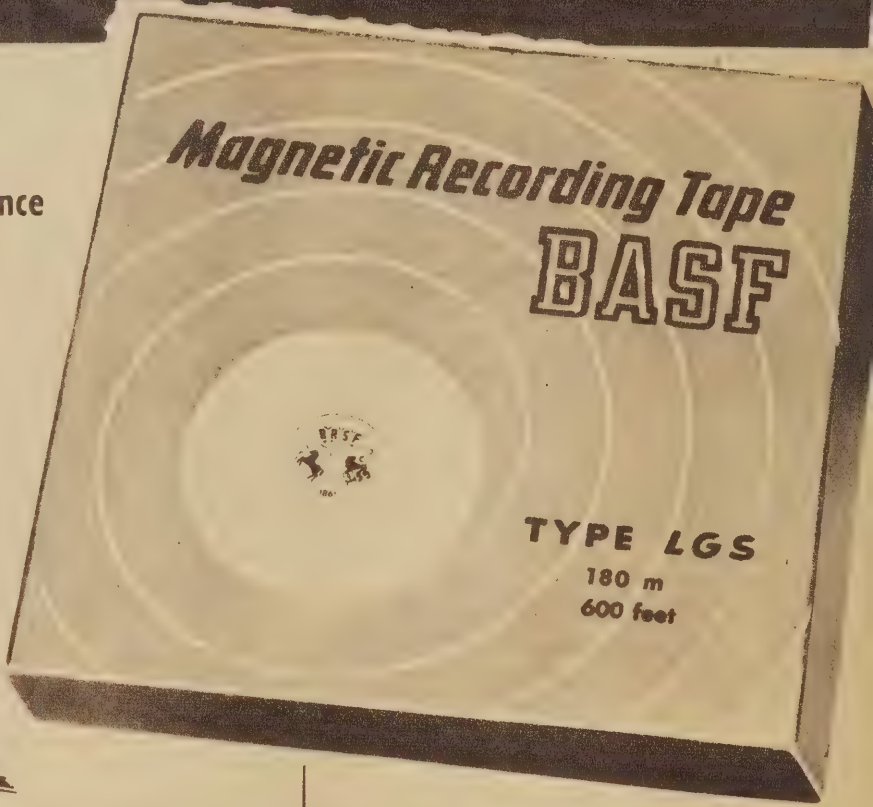

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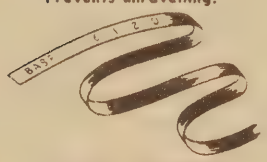

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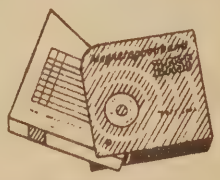

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ngle listening position, it is highly de-itable whether the stereo effect will worthwhile.

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So comes the question: "If I can't have effective stereo, is it not better to concentrate on mono?"

If the choice is between a single-binet mono system and a single-cabi-et stereo system, using the same gene-l order of equipment, you may as well ave the latter and derive what benefit om it you can.

If the choice is between a present gh-performance mono outfit and a mpromise stereo outfit of much lower eneral quality, then you'll probably pre-r the former.

But then I don't think that a lover of corded music would be really happy ther way. As always, he will strive for his "ultimate" and that now means the best stereo equipment he can afford and a suitable listening layout.

And, after all, is it unreasonable now-adays to centre our domestic planning around the modern facilities that we want? Already, television has brought about a revolution in room design and furnishing.

Is it unreasonable to suggest a speaker to either side of the TV set, so that the audience can view or listen as they so desire?

And what if the speaker boxes take up a bit of space? Don't they contribute more than a cabinet filled with cut-glass? Or sporting trophies belonging to a past era?

In other words, if you want a stereo system for serious listening, it's worth organising for, just as you've probably organised for other things in the past that you've wanted badly enough.

RECORD REVIEWS

By Julian Russel

Schumann—Piano Concerto in A Minor.

Grieg—Piano Concerto in A Minor.

Played by Solomon and the Philharmonia Orchestra conducted by Herbert Menges. HMV OALP 1643.

Schumann's piano music requires treat-ent unlike that of any other com-oser's. To put it briefly, there must e impulsiveness but no gush.

And Schumann's romanticism, unlike at of some later composers, was essen-ally innocent and free from morbidity.

Solomon fulfills all the requirements his elegant performance of the A inor. His playing, though always ex-ressive, is essentially non-aggressive and, hen the occasion demands, where figura-ions on the solo instrument are intended nly to decorate the orchestral part, is odestly reticent.

The result is a reading that is deeply elt and eloquently expressed, supported y an orchestral accompaniment that ever fails to reflect the soloist's moods.

Especially gratifying is the unspectacu-r nature of Solomon's playing. He laces his fine technique completely at e service of the music without any riving after self-glorification. The bal-nce between soloist and orchestra is lways admirably considered.

The sound is good.

Much the same might be said about e Grieg, except that some listeners may nd Solomon's — and the orchestra's — mpos occasionally a little wayward.

Apart from these rare passages, the mainder is a performance of great re-nement, though lacking nothing in spirit r that reason. The sound is generally od, but tails off a little toward the ndle, and I found my pressing im-oved by boosting the bass a little.

★ ★ ★

DEBUT—Piano recital by John Browning. Chopin: Black Note Study, Nocturne in D Flat Major, Op. 27, No. 2, Grande Valse Brillante in E Flat Major, Op. 18; Liszt: Mephisto Waltz; Bach: Two Chorale Preludes (Busoni transcriptions), "Now Comes the Gentiles' Saviour" and "In Thee Is Joy"; Schubert: Impromptu in B Flat Major; Debussy: Reflections in the Water; Rimsky-Korsakov: Flight of the Bumble Bee. Capitol P8464.

This pianist, too, uses restrained romanticism that avoids sentimental exaggeration. Twenty-six years old, he belongs to a younger generation than Solomon, and, like many of his young contemporaries, has a brilliant technique—one which he could use in a much more demonstrative manner were it not disciplined by good taste.

In the Chopin group he employs rather more rubato than is fashionable nowadays which, allied to a pearly, delicate touch, produces an effect not unlike the great Pachmann's.

This essential gentleness suits the bulk of his program in this recital admirably.

It fails him, however, in the Mephisto Waltz, perhaps because he finds difficulty in adapting a slightly introverted temperament to the composer's flamboyant ideas.

Some listeners may welcome this refined treatment, after hearing too many showy accounts of the piece, but others might miss just that touch of "devil" that the composer himself would indubitably have added.

The recital seems to have been assembled with the idea of displaying the soloist's versatility rather than profound interpretative powers.

The piano tone is excellent.

★ ★ ★

LISZT—Twelve Études D'Execution Transcendante for Piano played by George Cziffra. HMV OALP 7514 and 7515.

Cziffra's playing differs spectacularly from the two pianists mentioned above. He is a true extrovert, unworried by any considerations of modesty and concerned only with obtaining the most brilliant—and showy—effects from his instrument.

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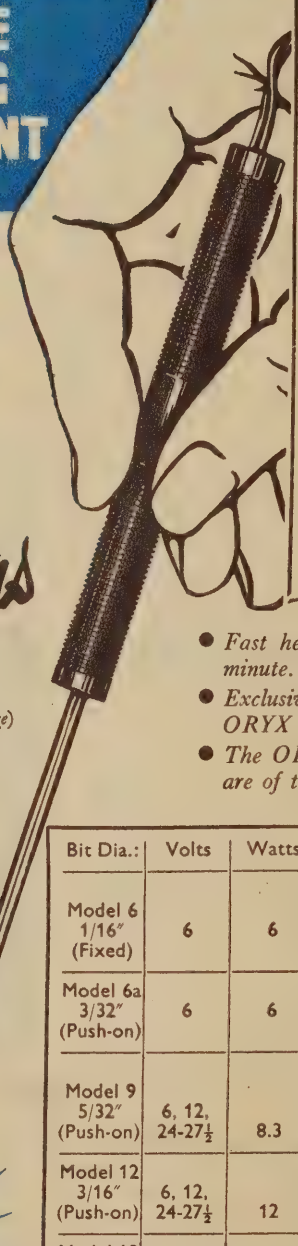

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previously issued discs seemed to fulfill effortlessly his every exacting demand, seems sometimes to be under some strain. Now and again his fast passages splash a little instead of running smoothly.

But at other times he makes ample amends by playing quite angelically.

In pieces of such complexity as these studies, however, some unevenness of execution is not surprising, and since the complete book, so seldom played in concert halls and so consistently interesting, is at present obtainable locally only in this version, these two discs may fill a useful gap on the market.

★ ★ ★

PIANO RECITALS by Svjatoslav Richter. Schubert: Moment Musical, Op. 94, No. 1; Impromptus Op. 90, Nos. 2 and 4; Chopin Study in E Major, Op. 10, No. 3; Liszt: Valses Oubliees Nos. 1 and 2; Liszt: Etudes Transcendantes Nos. 5 and 11. Philips A00535L. Moussorgsky: Pictures at an Exhibition. Philips A00534L.

Many critics consider Svjatoslav Richter to be the greatest pianist performing today and I am inclined to agree with them.

This opinion has been, in most instances, arrived at from hearing his recorded performances only, since he has so far never played west of the Iron Curtain.

On discs already released he has been heard in works by composers as widely different as Schumann, Prokofieff, Beethoven, Bach, Bartok and Rachmaninoff —and has played them all inimitably. Now, as if to demonstrate further his inexhaustible stylistic variety, he offers the pieces listed above.

They were recorded live during two concerts at Sofia, Bulgaria, in February 1958, and the sound varies considerably in quality from piece to piece.

Moreover, the coughs produced by the Bulgarian audiences suggest that the records were made during a severe Balkan flu epidemic, and, to provide additional discomfort, the same audiences applaud irritatingly, loudly and at great length after each item in the first recital.

But none of these intrusions nor the engineering shortcomings dim the lustre of his wonderful playing.

The ravishing delicacy of the two Liszt trifles, the Valses Oubliees, followed by the contrasting complexities of the great Transcendental Studies, cover an enormous field of expression.

The clarity of articulation of the Fifth Study, taken at the speed Richter plays it, must be heard to be believed. It is an amazing technical achievement. Yet there is nowhere any hint of showing-off.

Richter's treatment of the nocturne-like 11th Study created in me a desire to hear him in Debussy, a composer whose style this Liszt piece dramatically anticipates.

There is nothing formal about Richter's playing of the Schubert numbers. He keeps them all charmingly naive and affectionate.

He bustles into his introduction to the "Pictures at an Exhibition" and goes straight into "The Gnomes" without the loss of a beat.

But on the first side of my pressing, loud tape hum and a medley of background noises—one of them like paper tearing—proved very tiresome.

These are temporarily obliterated by the loud chords of the "Ox Cart" item but return when the music becomes quieter.

Richter's astonishing control of timbres makes his "Ballet of the Unhatched Chickens" sound like the chirping of tiny birds, quite unlike the pianistic scherzo movement usually heard.

The hum disappears on the second side, but the audience behaves no better.

"Baba Yaga" I can only describe as electrifying. And the interesting fill is a comparatively unknown Prelude by Rachmaninoff.

★ ★ ★

BEETHOVEN — Piano Concerto No. 1 in C Major, Op. 15; Piano Sonata No. 24 in F Sharp Major, Op. 78. Played by Claudio Arrau and the Philharmonia Orchestra conducted by Alceo Galliera. Columbia 330CX1625.

This is the most beautiful performance of the work I can recall. Arrau varies his tone from forceful to limpid to sparking in a manner that keeps the mind as delighted as the ear. And after a start in which he and the conductor seem momentarily to be at odds over the matter of tempo, the accompaniment goes on to be entirely worthy of the fine solo.

Both enjoy the benefit of excellent engineering. The piano tone is full without any after-clang, and the orchestra presents plenty of detail with impressive clarity.

The balance is consistently admirable, both between soloist and orchestra and between the orchestral instruments themselves.

Interpretatively, too, the performance has unique features. Most of these are to be found in the Finale where briskness, not so much of tempo as of response, imparts an unusual celerity to the movement, and in the slow movement, where some of the ornamentation of the solo part is as unusual as it is entrancing.

Then, as a bonus, the fill offers Arrau in an exquisite account of the F Sharp Major Sonata, usually taken to be a portrait of the Countess of Brunswick whom the composer passionately admired—for a while.

★ ★ ★

BEETHOVEN — Piano Concerto No. 3 in C Minor, Op. 37; Rondo in B Flat Major. Played by Julius Katchen and the London Symphony Orchestra conducted by Pierino Gamba. Decca LXTA5500.

This, too, is a first class performance, characterised by brilliance that leaves the lyricism of the work unimpaired.

Many young pianists of Katchen's age are satisfied to achieve surface virtuosity and leave the poetry to look after itself.

But Katchen's playing, despite his formidable technical equipment, is always deeply poetical.

A run through the hushed slow movement will demonstrate his eloquence better than a thousand words of description.

In this concerto, too, the orchestra makes an unimpressive start but quickly adjusts itself to the soloist's needs as soon as he enters, and remains with him from there on.

In the Finale Katchen is forceful rather than gay. The movement never seems to skip along like a happy girl as it did when played by Schnabel.

But Katchen's substitution of vigour for light-heartedness, while perhaps not

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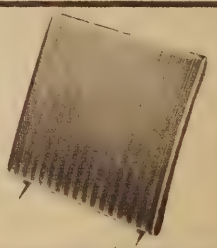

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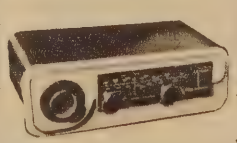

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entirely satisfactory is at least valid, and might even be preferred by some listeners.

The sound and balance are good.

The Rondo for Piano and Orchestra might be pleasingly novel for some listeners. It is the one Beethoven left unfinished and its completion is attributed to Czerny.

It provides a bright epilogue to a most enjoyable disc.

★ ★ ★

DVORAK—Symphony No. 5 in E Minor, Op. 95, "From the New World." SMETANA—"The Moldau," from "My Country." Played by the Berlin Philharmonic Orchestra conducted by Herbert von Karajan. Col. 33OCX 1642.

As a rule Karajan can be relied upon for a performance governed by a cool, alert mind unmoved by romantic extravagances. Not infrequently he has substituted brilliance and incision for warmth, often, in my opinion, successfully. But he has seldom failed to miss any dramatic points in the works he has directed.

This present performance of the "New World" is strangely uncharacteristic. There is the old splendid precision of attack and release and the phrasing is as shapely as ever. But Karajan's reading is heavily Teutonic and his climaxes, though impressive in dimension, sound as if they had been imposed on the structure instead of growing naturally out of it.

He opens most impressively. The Introduction is dignified though not pompous and the constantly shifting dynamics superbly controlled.

But that behind him, his tempos acquire an alien cautiousness resulting in a lack of spontaneity better suited to Brahms than Dvorak.

The second subject of the first movement is paced so deliberately that it seems to ponder. And the famous Largo suggests Germanic philosophising rather than the American forest that is supposed to have inspired it.

And, even more surprisingly for Karajan, the trio of the Scherzo loses much of its natural sprightliness.

None of this, however, must be taken as meaning that the playing of the Berlin Philharmonic is ever less than highly accomplished. The symphony just lacks the life imparted to it by Kubelik and the Vienna Philharmonic on disc, and by Ancerl and the Czech Philharmonic at the performance during their recent tour of Australia.

Much compensation for the interpretative shortcomings can be found in the engineering which is outstanding in depth and richness of tone.

And there is further compensation in Karajan's grand account of the Smetana piece used as a fill on the second side.

I have never heard this played with such stately fluidity, and its forward movement is quite irresistible.

★ ★ ★

ALFVEN—"Dalecarlian Rhapsody" (Swedish Rhapsody No. 3, Op. 48); Festival for Full Orchestra, Op. 25. Played by the Stockholm Philharmonic Orchestra conducted by Stig Westerberg. "The Prodigal Son" (Ballet Suite). Played by the Royal Swedish Orchestra conducted by Hugo Alfven. Westminster WG-W-18059.

Despite the enormous number of classical records appearing on the local market, works by "new" composers are rare indeed.

Hugo Alfven is not "new." He was born in Stockholm in 1872 and at the time of writing, according to the sleeve notes, is still alive. Nor has he anything new to say in his music, as exemplified on this disc. But his name will probably be as unfamiliar to most discophiles as it was to me.

Alfven's music is strongly based on Swedish folk tunes, to which he has added, during his long career, traits that show the influence of composers as different as Tchaikowsky, Richard Strauss and Dvorak, with a hint here and there of popular English writers of lighter classics.

The three pieces presented in this concert are all expertly put together and efficiently played.

The Dalecarlian Rhapsody recalls Grieg in the opening bars, but develops a more individual style as it progresses.

The Festival for Full Orchestra takes one on a merry romp in the open air. And the Ballet Suite from The Prodigal Son introduces many hearty tunes imaginatively developed, not one of which, however, reminded me of the legend's Biblical origin.

★ ★ ★

HOLST—The Planets, Op. 32. Played by the B.B.C. Symphony Orchestra with the B.B.C. Women's Chorus conducted by Sir Malcolm Sargent. World Record Club, TE205.

This new issue is not to be confused with Sargent's Decca performance with the London Symphony Orchestra released here some three years ago.

Both the old and new versions have their fine moments, though some of them occur in different spots.

And there is, too, the splendid reading by Boult with the Philharmonic Promenade Orchestra for Nixa that appeared on the local market even earlier than the first Sargent.

But let me say at once that, other considerations apart, the excellence of the engineering of the World Record Club disc puts it ahead of its two competitors. These were outstanding at the time they were produced, but sound engineering has come a long way since then and the benefit is to be had in the new Sargent.

Its dynamic range, though wider, is better controlled, and the spacing of the instruments gives the orchestra not only better perspective but increased tonal richness.

Then there is a price factor to influence potential buyers. Without any sacrifice of quality the World Record Club disc costs only £1/17/6, a figure much below that charged for the other two.

I missed most in the new version the eerie quality of the voices as they were heard in Sargent's first "Neptune" — voices that seemed to reach us from light years away. But weighed against the vivid and imaginative playing elsewhere, this can be regretted without inconvenience.

The new performance has been put out on stereo overseas. It would be welcome here in that form, too.

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Recent Stereo Releases

Tchaikowsky — The Nutcracker. Complete Ballet. Played by the Orchestra of the Suisse Romande conducted by Ernest Ansermet. Stereo, Decca. SXLA 2092/3.

Some stereos do not display an overwhelming superiority over the same performance on mono. This is one of them. The sound is fine, but the mono version was so outstanding that only a slight improvement has been effected by transfer to two channels. I prefer, however, the Decca quality both on mono and stereo to the great brilliance of Mercury's old mono version conducted by Dorati, which had an embarrassingly wide dynamic range for playing in an average-size room.

Balance in the Overture to the new Decca is not consistent. The woodwind sometimes receives too much weight against the violins' figurations. There is, though, always a lovely transparency and clarity. But that over, except in isolated spots, the balance is faultless.

Particularly pleasing is the manner in which the percussion group, which the composer keeps more than normally busy during the ballet, has been blended into the fabric so as not to make the listener feel he is being constantly beaten over the head with a tambourine.

Indeed this instrument in the well-known "Dance Arabe" just whispers its rhythmic rustle under the low notes of the clarinets.

The strings' tone throughout is full of vitality, yet never hard or wiry. Too lush a tone is also skilfully avoided. And the engineering has been managed so that, however suddenly a pianissimo might occur, no trace of the preceding loud chord is left hanging in the air.

The solos are brilliantly played without any striving after self-glorification by the soloists.

And the discipline imposed on this fine orchestra by its distinguished conductor never makes it miss a dramatic point while consistently preserving the fairy-tale atmosphere of the score.

★ ★ ★

Tchaikowsky — Selections from Swan Lake. Played by the Orchestra of the Suisse Romande conducted by Ernest Ansermet. Stereo, Decca SXLA 2107/8.

This stereo set is a big improvement tonally on the mono version released last year. It has greater presence and much more of the detail in the score is audible without close listening.

The performance is in every way admirable. All the splendid features of the Nutcracker performance are to be found here, too.

Once or twice, slightly overstressed rhythms suggest geese rather than swans but these blemishes can be easily overlooked, since they interrupt so very briefly one's enjoyment of the work as a whole.

As the title indicates, the score is not presented complete. Balletomanes will miss one or two items they probably expected to hear but will find compensation in the addition of less familiar excerpts.

★ ★ ★

Tchaikowsky — Selections from Swan Lake. Played by the Ballet Theatre Orchestra conducted by Joseph Levine. Stereo, Capitol SP-8416.

This single 12-inch contains a much briefer selection than the Decca set but you will find most of the important items included.

The sound is good, but the conductor's approach to the score lacks Ansermet's beautiful emotional equilibrium.

Everything is made to sound as lush as posible.

Some listeners may admire this schmaltzy treatment. I found it, despite the orchestra's other undeniable merits, just a little too rich.

An American recording, it is pleasingly free from the edgy quality that occasionally disfigures engineering that originates in that country.

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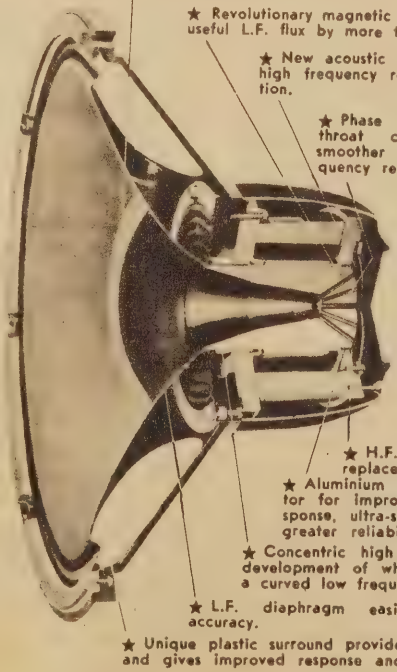
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AMATEUR BANDS WITH BILL MOORE

WEIL ON 4-YEAR DX-PEDITION

Expeditions to remote parts to provide amateur communication with stations all over the world are these days commonplace. Well known rover Danny Weil, VP2VB, is off again on another journey.

ONE of the sagas of amateur radio has been the journeys of Danny Weil, VP2VB, in his yachts Yasme I and II and their subsequent loss by shipwreck in the Caribbean and the Pacific.

Danny is soon to leave on yet another world tour to provide amateurs with contacts from strange places. This time, however, it will not be a solo venture and he has supporting him an organisation formed in the U.S.

Editor of "Yasme News," Ed Stanley, W4QDZ, provided the following information on organisation and future operation of VP2VB.

The Yasme Foundation has been formed and incorporated in Florida as a non-profit co-operative company, with a charter to promote amateur radio working, international goodwill and to assist amateur marine operation. It is financed by the members of the foundation.

Yasme III should leave on a world cruise about the end of February. Danny this time will be accompanied by W8LMI, a doctor, and ZL1AV, a commercial operator. The new yacht purchased is a Canadian vessel, 50ft long and powered by a 135 h.p. diesel engine. Radio equipment carried will include SSB, AM and CW transmitters, with a special 1 KW, 50 mc/s outfit that should provide interest for the VHF gang.

Equipment is semi-portable, so it can be taken ashore to be operated to fulfil the requirements for official country recognition.

The trip is expected to take approximately four and a half years and will be via the Panama Canal, Pacific, Indian and Atlantic oceans, visiting all the rare prefix countries on the way. The DX fraternity can really expect unusual calls to be heard during the wanderings of Yasme III.

KEEN ACTIVITY ON VHF BANDS

RECORDS were shattered in January on the VHF's in southern States when the 288 mc/s band opened. Many stations made good contacts and showed the value of a contest, such as the Ross A. Hull Memorial Event, in concentrating activity on the VHF's during the higher frequency bands DX season. VHF amateurs in true tradition are always improving their equipment, experimenting with their arrays, in an endeavour to open new paths.

For the first time contact was established on 288 mc/s. across Bass Strait on January 10. VK3ALZ Glenroy and VK7LZ in Launceston made the QSO with signals varying between S4 and S9, the distance covered being 290 miles. Actually VK3ZCG heard VK7LZ a few nights before, the first occasion on which signals had been heard from Tasmania on the band.

The VK7LZ—VK3ALZ contact was repeated after midnight for points score in the Ross Hull contest.

The 144 mc/s band was also wide open and VK3ALZ worked with VK7LZ, VK7PF, VK7ZAA, VK7RL, VK7BQ and VK7ZAK. The last-mentioned station was mobile out of Hobart on Mt. Wellington and was using only 8 watts input. The distance from VK3ALZ's QTH is 400 miles.

Ian, VK3ALZ, uses crystal locked converters on 50, 144 and 288 mc/s. The transmitter is crystal controlled on 288.18 mc/s, and a VFO used on both 50 and 144 mc/s. The schedule frequency on 144 mc/s. is 144.1 mc/s.

Inputs are 90 watts on 50 and 144 and 60 watts on 288, feeding long Yagis —a 13ft, 16 element job on 288, 36ft 19 element job on 144 and a 30ft long nine element job on 50 mc/s.

VK7LZ uses a crystal controlled transmitter on both 288 and 144 with 80 watts input; operating frequencies are 289.24 and 144.62 mc/s. Crystal locked converters are used and the arrays are a 5 over 5 job on 144 and a long 16 element Yagi on 288.

Frequencies operated by VK7s on 144 are VK7PF 144.65 mc/s, VK7RL 144.05 mc/s, VK7ZAA 144.22 mc/s, VK7BQ 144.32 mc/s.

Tests conducted on 50 mc/s. between VK7LZ and VK3ALZ soon after the 288 and 144 mc/s contacts were negative, showing ducting was responsible for the higher frequency QSO's.

VK7's running regular schedules with VK3 include VK7ZAK, 144,018 mc/s, who operates Mondays, Wednesdays and Fridays, at 1930 EAST.

VK7LZ and VK7PF beam to VK3 on 144 mc/s. at 2,000 EAST and the VK3's beam to VK7 at 2000 hrs. EAST on the frequencies stated.

Another feature of the contest period was the regular appearance of the JAs, sometimes up to S9 in VK7 and audible in other States. Some good sporadic E openings occurred during the period and VK9XK provided an interest for many of the 50 mc/s operators.

His signals were very consistent but, at the moment, he is away on long service leave.

In January VK4HD heard several W6s and one K9 on 50 mc/s, but was unable to raise them. According to reports the ZL's have been hearing South American commercials up to 49 mc/s and predictions favour April and May as a good period for DX working from Australia to the Americas on 50 mc/s.

VK5ZDL in Darwin has been working Townsville on 50 mc/s. and stations in other States are looking out for him.

9M2DQ (not GM2) has been heard in Brisbane but not contacted. Interstate openings were common but the usual VK2/VK5 S9 plus exchanges were not as consistent as during the previous summer.

SUNSPOT CHANGE

Generally it would appear that there has been a dropping off of F2 layer DX contacts throughout the world, as could be expected with the passing of the sunspot maxima.

Trans-equatorial scatter propagation has provided most interest both here and overseas. The JA/VK openings have been consistent and the ZE2JV, Southern Rhodesia—ZC4WR, Cyprus, circuit has been open practically daily. Consistent north/south paths from LU Argentina to West Africa and North and Central America have been observed. ZL to W/K contacts have been spasmodic; one reported QSO was between W6FZA and ZL1BJ late last year.

Stateside amateurs have been working hard to complete a 50-State WAS on 50mc/s. Competition was very keen and W6GOX was the ultimate claimant for the first certificate only 18 minutes ahead of the nearest opponent.

Another form of 50 mc/s propagation is currently being studied in North America. Transmissions from KG1FN through the Auroral Zone have been heard at distances up to 2,000 miles at night.

ANOTHER REASON

KG1FN is located on an ice island within the Arctic Circle and contacts have been made in neither the F2 nor sporadic E seasons and do not fit into any accepted VHF propagation mode.

Signals are characteristic of those heard on east-west paths during auroral openings.

This new form of propagation has been first observed by amateurs according to Ed Tilton, W1HDQ, QST VHF Editor.

With more amateur stations being located in the Arctic and Antarctic each year, exchange of signals via this mode of propagation could well match T.E. propagation as the most outstanding amateur propagation discovery of all time.

A newcomer to 50mc/s will be VK0ED, Antarctica, operating from the end of March. He will operate on 50.040 mc/s and will use 14080kc/s as a liaison frequency.

Jim Cummings, VK2PM, holidaying on the far south coast of N.S.W opened a new path to Sydney on 144mc/s. Using his portable equipment, from near

Eden, he contacted a number of Sydney stations over a distance of approximately 225 miles.

★ ★ ★

On the L.F. bands

BESIDES all the VHF DX activity over Christmas the low frequency gang in the northern hemisphere are making a serious endeavour to increase their DX tally on the 160 metre band. The doyen of those frequencies is W1BB who has contacted a total of 55 countries on that band. The sunspot cycle is swinging back to the L.F. bands. Quite a number of G's have worked with ZL on the band and enthusiasts are waiting a sunspot decrease.

The 160 metre gang mainly use vertical antennas. Many of them base loaded 66 foot high affairs, they want the lowest possible angle of radiation. Others who can only erect horizontal antennas generally use extensive buried earth systems. One of the problems that arise when working on this band is that quiet nights with low static and noise levels are not good for distance working. When propagation conditions are favourable, they bring plenty of noise and static.

★ ★ ★

Annual convention

THE 10th annual convention of the N.S.W. Division of the WIA was held in the grounds of VK2WI, Dural, over the Australia Day weekend. It was the first event for the division in their jubilee year, the fiftieth anniversary of the foundation in 1910.

The weather was not very kind; there was light rain at times, but nobody was particularly worried. It was a welcome relief after the heat wave, with temperatures for four days well over the century mark, earlier in the week.

The assembly was the largest ever recorded in the State. 172 licensed amateurs and 75 associate members registered and, with 165 ladies and children, brought the attendance over the 400 mark. Much hard work went into the organisation and preparation of the grounds and all were pleased to see so many attend and so many leave with pleasant thoughts of the convention.

It was a different type of show from those previously conducted, with displays by various sections and member groups of the institute.

Visitors wandered around viewing the shows with plenty of time in between to exchange stories with their friends. The registration and car parking was in the capable hands of Tim Mills, VK2ZTM, secretary, and members of the S.W.L. section. They did a tremendous job with cars spread out over a large section of the five acres of the grounds of VK2WI.

Next tent in line was that of the State secretary, Norm Beard, VK2ALJ, who was there to explain the work of the division and collect any moneys.

With him was State QSL officer, Frank Hine, VK2QL, who supplied cards to the many inquirers.

Close by was the old-timers' tent with its display of vintage equipment organised by Joe Reed, VK2JR, assisted by ancient amateur Wal Hannam, VK2AXH. The show created quite an impression with equipment never viewed by the "young squirts."

In more modern vein Harold Burtoft, VK2AAH, showed and explained the habits and workings of these latest devices. Technical information was available and the display attracted quite a crowd.

S.S.B. EQUIPMENT

The SSB display manned and equipped by Leo McMahon, VK2AC, Stan Bourke, VK2EL, Don Pollard, VK2ASW, and Barry White, VK2AAB, was a centre of activity. Feeding a pair of half waves in phase on 14 mc/s the transmitter worked into a number of overseas countries including Liberia. Judging from comment a number of amateurs were converted to this mode. A few of the Ancient Modulation gang were talking on the side of phasing units and the like.

The wealth of disposals was housed in the emergency power supply hut and acted as a magnet attracting amateurs from all directions as they parked their cars. Amateurs cannot resist a bargain, and they were observed scuttling back and forth with large and small parcels loading up their cars. The sale was in progress for just on three hours. Members of the disposal committee, Allan Williams, VK2FH, and Harry Solomons, VK2AJZ, with many helpers were kept busy handing out the equipment.

The VHF section's display was very interesting and attracted much attention. It covered transmitters, receivers and antennas and featured cascode converters. A telescopic steel mast complete with an 8 over 8 144 mc/s array brought by VK2AI was erected after off loading from a panel van. Section President John Lark, VK2ZAV, with help from section members, arranged the exhibit.

The 144 mc/s blindfold hunt conducted by the Blue Mountains section was very popular, especially among the youngsters.

Some heats were conducted at high speed with competitors dashing up the track ahead of the judges. Section President Wal Cromie, VK2MZ, provided the transmitter and halo (not his) and was assisted by Norm Durham, VK2QA, Ken Moore, VK3AVK, and Dave Melbourne, VK2NK. Winners of the finals were: Ladies, Mrs Kinscher, XYL VK2ADL; girls, Judith Johnson; boys, Peter Agar, son of VK2AIM; gents., Peter Adams, VK2JX.

The evening session consisted mainly of a quiz show compered by Max Pleffer, VK2MP.

The quiz champion was Lindsay

NEWS OF AMATEUR ACTIVITIES

You may possibly know of some activity in your area, which could be of interest to amateurs generally. If so, drop a line to Bill Moore, writer of these notes. His address is Pitt Street, Springwood, N.S.W.

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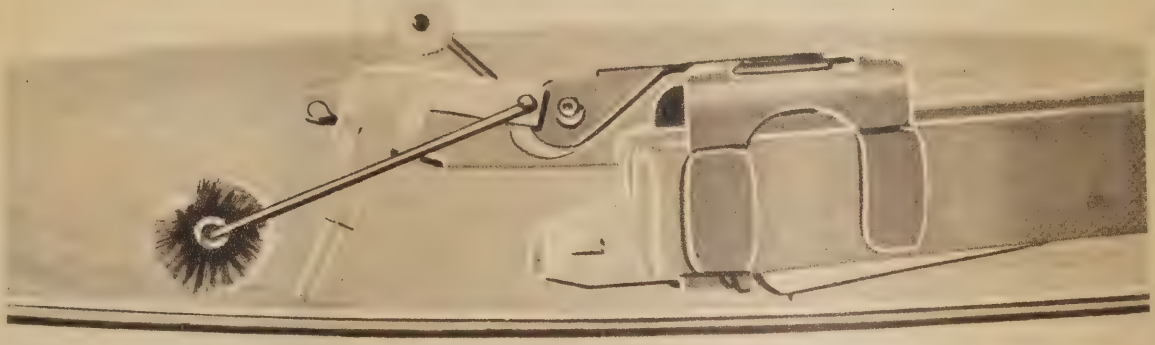

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Douglas, VK2ON, who answered nearly all the questions, and runner-up Bill Shakespeare, VK2ADF. The 16 contestants were selected by ballot and all received prizes.

Many prizes were donated by Sydney radio houses and disposals equipment. The total value was in excess of £100.

The official opening of the convention was carried out by the State President, Dave Duff, VK2EO, who introduced councillors present, Ted Whiting, VK2ACD, Max Pleffer, VK2MP, and George Rutter, VK2CB.

Also introduced was the Hunter Branch President, Lionel Swain, VK2CS, and old-timers Wal Hannam, VK2AXH, and Bill Otty, VK2ZL.

As is necessary for events of this kind there must be plenty of willing helpers—there were. Some of the workers not previously mentioned are as follows, with apologies to any missed.

Firstly, the ladies who worked all day —there was always a cup of tea available. They were Mrs Duff, wife of the President; Mrs Whiting and her daughters of the VK2ACD family, and Mrs Stahl, of Katoomba.

There were the five gentlemen, VK2ASF, VK2AEZ, VK2XS, VK2SG, and VK2ST, who drained the emission of the 809's in a creditable manner—not for themselves but for others!

Les Stahl did a fine job with the lucky dip and the disposal of whip antennas.

Others included Muriel VK2AIA, and Noel, VK2AHH.

It was the finest event of its type held and a forerunner of many more of similar kind.

★ ★ ★

Country lists

COUNTRY lists, as provided for DX certificate purposes by the various national amateur societies, vary so greatly that it is difficult to know which one should be accepted and followed.

Undoubtedly these lists are prepared in good faith and represent the societies' policy on the recognition of countries for their awards.

It would not appear that a list acceptable to all authorities will ever be produced.

A list was recently published in this magazine showing Tasmania as a separate country to the mainland. However, the latest A.R.R.L. country list for 1960 groups Tasmania with Australia as a single country. In the same issue it was announced that Willis Island, a meteorological station some 250 miles off the coast of Queensland, is now recognised as a separate country for DXCC award purposes.

Years ago Tasmania and the mainland were separate countries, and it appears the VK7s should start a publicity campaign if they desire separate country status. At least they have their own State Parliament and some degree of autonomy under the Constitution.

It is with interest the status of Hawaii and Alaska as the 49th and 50th States of the U.S. under Congress are noted, and they must be in a similar position to Tasmania politically.

Surely Tasmania would be a better proposition for separate country status than either Willis or Lord Howe Islands.

Only a few more on the list will enable the "Big DX Boys" attain the 300 country tally.

Russian amateurs

THE bands for operation of Russian Amateur Radio have been re-arranged, extended privileges have been granted to newcomers and some power increases allowed.

Beginners may now use the 7,000 to 7,100 kcs and 28 to 29.7 mc/s bands. The 3.5 mc/s band has been extended by 50 kcs to 3.65 mc/s. Frequency tolerances must still be better than 0.1 per cent and the new maximum power figure is 200 watts in special cases.

The power for beginners is limited to 10 watts.

Russian stations may use the band 144 to 146 mc/s, but with a power limit of 10 watts. The only other U/VHF band available is from 420 to 435 mc/s. They are permitted to use the normal HF plus these two allocations.

★ ★ ★

Geneva conference

THE A.R.R.L. has stated that it is with considerable gratification they announce that the Geneva 1959 Radio Regulations provide for a continuation of use of all frequency allocations previously available in Canada and the United States.

It was the opinion of A.R.R.L. general manager, A. L. Budlong, W1BUD, that, although there were instances of amateur privilege reductions in other parts of the world, the amateur body in general made out very well internationally, considering the obstacles it had to face.

★ ★ ★

Radio club grant

SYDNEY newspapers covered the story of a grant by the Goulburn Workers' Club of £100 to the Goulburn Radio Club for the purchase of equipment for training and instructing young people in radio. Not often has a grant of this kind been made; it is notable that in least one area there is an appreciation of the value of amateur radio to the community, and as a training ground for youngsters in an interesting hobby.

★ ★ ★

Technical lecture

LECTURER at the January meeting of the N.S.W. division of the W.I.A. was Mr Peter Griffin, of the Department of Civil Aviation, and his subject, "Radio Aids to Navigation." He described the operation of the varied equipment in operation at Kingsford Smith Aerodrome. Of particular interest to members were the antenna arrangements, reducing beam widths to five degrees in some cases.

It was an instructive lecture covering a phase of radio work with which most amateurs are not familiar.

Peter Alexander VR2DA (ex VK2PA Port Macquarie) DXpedition as ZM7DA on Tokelau was extremely successful, despite a few incidents by way of dropping equipment into the drink on the way out, 3,000 contacts were made during the stay in a total of 70 countries Europeans were very scarce, however. Peter operated from the Mission Station and caused quite a stir among the DX fraternity. He will be returning later to VK for a holiday.

Peter hopes to be able to lecture to the N.S.W. division on the features of the DXpedition.

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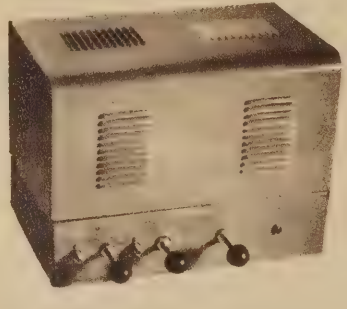
136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

636 KING STREET NEWTOWN–LA7008



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Public Address Range
240v-AC

6 Valve, 10 watt, £14/17/6
6 Valve, 25 watt, £25/7/6
6 Valve, 40 watt, £32/7/6
7 Valve, 20 watt, £22/17/6

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6 valve, 6v, 10 w. £18/15/
7 valve, 12v. 12 watt, £19/15/
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BATTERY—AC OPERATION

6 valve 6 x 240 10 watt, £20/15/
7 valve 12 x 240 12 watt, £21/15/
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240V-A.C.
20 watts Output.
7 Miniature Valves.

Built-in Multi Match output Transformer. Specially suitable for music systems, guitar and where wide-range reproduction is required.

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1,200ft spools .. £1/12/6
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6 WATTS OUTPUT

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R. TV & H. '59 TV

21-inch 110 DEGREE

The complete kit of parts to R.TV and H. specifications and layout including: VALVES, TESTED STEANES TURRET TUNER and I.F. STRIP, TUBE MOUNTS AND MASK.

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Dual Wave with R.F. Stage.
8 VALVE, 6BA6, 6AN7, 6N8, EM80, 12AT7, 6BM8, 6BM8, 5Y3.
2 Rola 8MX Speakers.

£36/15/-

10 VALVE. 6BA6, 6AN7, 6N8, 12AT7, EM80, 2 x EF86, 2 x EL84, 5V4.
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Send for full details on Radiogram Chassis, TV and Amplifiers.

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90 or 110 degree. Fully guaranteed.

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14 watts output
6BA6, 6AN7, 6N8, EM80, 2 x EF86, 4 x 6BM8, 12AT7, 5V4.
2 Jensen 12in Woofers,
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12 valve. Converted to 240v A.C. Thoroughly Tested. Re-aligned. Latest Ovaltone Permag Speaker

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12C8	12/6	6K7	5/
6J8	17/6	12SJ7	12/6
VT501	12/6	12SL7	12/6
211	17/6	6SH7	7/6
1C6	12/6	47	12/6
1J6	12/6	843	£1/10/
3A4	15/	957	10/6
3B7	10/	1625	£1
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304TH	£3/-/-	1619	£1
6AM5	15/6	9001	8/6
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1K7	5/-	VR75/30	15/
1M5	5/	RK48A	£3
6X4	12/6	954	7/6
12AT7	17/6	VR105/30	15/
832	£2/10/	6AC7	5/
6J5	9/6	EL3NG	12/6
834	5/6	2X2-879	5/
9003	12/6	866A	15/
6J6	15/	6AJ5	9/6
6J7G	7/6	6SN7	12/6
5N7	10/	VR150/30	15/
KTW62/6U7	7/6	6AK5	17/6
1D5	7/6	9006	5/
6F6	12/6	6AS7	12/6
EF37	12/6	6A8	17/6
6X5	10/	CK1013	15/
6V6	12/6	6SA7	15/
6E5	12/6	6SL7	15/
12K8	12/6	6R7	7/6
1T4	10/	6AB7	12/6
1P5	7/6	EF39	12/6
803	£1/5/	EK32	15/
VT502	12/6	EBC33	12/6
1L4	5/	809	9/6
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AV11	3/9	7F7	12/6

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100 assorted. 40 valves ¼-½-1 watt

9/6

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Suitable for TV Pic. Tubes.

VCR 138A. 3in	17 6
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An excellent Low Pressure Air Compressor. 7 c.f. per min., 25lb pressure.

£2/17/6

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12V 240V 60 Watt	£3 7 6
32V 240V 60 Watt	£3 7 6
12V 240V 100 Watt	£4 5 0
32V 240V 100 Watt	£4 5 0

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12 volts DPDT. 5 amp	£1
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24v.	250v. 60mA	£1 5	0
12v.	500v. 350mA	£8 10	0
12v.	1200v. 200mA	£6 10	0
24v.	250v. 100mA. New	£2 0	0
12v.	235v. 50mA	£2 15	0
12v.	350v. 50mA	£2 15	0
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New Lifeboat Transmitters. 144 meg. Battery powered.

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AMERICAN WALKIE TALKIE 536

Complete with valves, 1 crystal, coils. Good condition

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Matched crystals and coils for 536 and 611 Units £2/10/ Per Set. Postage 1/.

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£1/2/6

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Mutual Conductance Test. Switched element selectors Cannot become obsolete.

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MINIATURE HI-POWER MOTORS

With Gearbox. 100 to 1 reduction. 24v. Reversing. Ideal beam swinging unit.

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Coils B/C, 455 KC	9/6
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Slug tuned H.F. coils to suit 44 meg.	4/6

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Standard P.M.G. Type. Pedestal Magneto Phones. Tested. In perfect order.

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Band A only. Can be modified for other bands.

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Communications Receivers. Test equipment. P.A. Gear, Large or Small surplus stock. Best prices. Call, write or phone any time.

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Complete with 15 valves and power supply.

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Battery powered. 9-1.4 miniature valves. 2 to 4½ mcs. Crystal controlled or M.O. Complete with valves and 1 Crystal.

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350 v. 100 MA. plus 2000 V. Fully filtered.

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240V A.C.

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As used for AR8-AT5 Stations 575V 350mA plus 250V. 100mA Plus 12V DC 10amp. Tested New Condition

£18/17/6

NEW CRYSTALS F243 HOLDERS

Following Frequencies.

4840	5397
4495	5205
4950	5295
4852	5780
4397	5852
5205	6235

10/- EA.

Postage 1/. Special price 100 lots.

522 TRANSCEIVERS

Complete with Valves. Excellent Condition.

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522 Receivers. Complete with Valves **£5/17/6**

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TYPE 46 TRANSCEIVERS

Small Pouch Type. Battery Powered. Locked Crystal Units. 3.5 to 9mcs. Range to 10 miles. Complete with valves and instruction book.

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AMERICAN "WIREK REPORTER" TAPE RECORDERS

Dry battery powered. Miniature. Air tested. Good order.

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24V 1500 WATT GENERATORS

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Less Valves.

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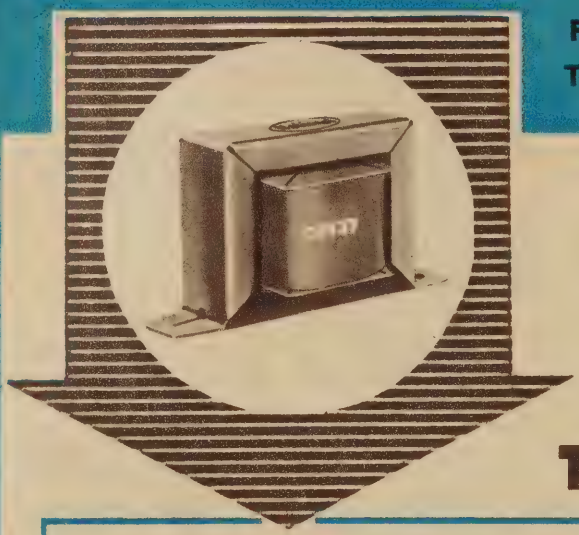

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National

BOBBIN TYPE TRANSISTOR TRANSFORMERS

This NATIONAL Buyer's Guide will enable you to select the right National Components

R. T. & H. CIRCUITS	ISSUE	DRIVER	OUTPUT
RECEIVERS			
Three Transistor Mantel	March, 1959	—	FLA375c/3.5
Transporta Four	October, 1959	—	"
Four Transistor Superhet	May, 1959	—	"
Transporta Six	August, 1958	FLA3000/2000c	"
Transportagram Six	October, 1958	"	"
Domestic Portable Receiver	November, 1959	"	"
Transporta Seven	February, 1959	"	"
CAR RADIO			
1959 Karset	January, 1959	LLA8000/20 (L.T. Choke	LLA20/3.5FB LLA.02/1100)
AMPLIFIERS			
Telephone Amplifier	April, 1958	FLA3000/2000c	FLA300c/3.5
Intercom Amplifier	June, 1958	"	"
Transistorised 2-unit Intercom	January, 1960	"	FLA375c/3.5
Morse Practice Oscillator	October, 1959	—	"
10 Watt Transistor Amplifier	November, 1959	D5437	C5420

POST THIS COUPON TODAY!

Australian and Overseas Agents:
Wm. J. McLELLAN & CO. PTY. LTD.
126 SUSSEX ST. (near King St.), SYDNEY. BX1131.
VICTORIAN AGENTS:
Australasian Engineering Equipment Co. Pty. Ltd., 476 Latrobe St., Melbourne. FY2638.
FACTORY REPRESENTATIVES—Queensland: K. H. Dore & Sons, Brisbane. B0268. South Australia: S. L. Andrew & Co. Ltd., Adelaide. W1827. Western Australia: I. W. Holman, Perth. BA8190.

Please forward me details on National Power Transformers ☐ Filter Chokes ☐ TV Transformers ☐ Transistor Transformers ☐ Stepdown Transformers.

Name .....

Address .....

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Supplier (Optional) ..... RH 3/60

ON SHORTWAVE BY ART CUSHEN

LONDON USES NEW FREQUENCIES

Rapid growth in the number of frequencies, which are being used by London, has been noted in the past month and the station's recent policy change to permit verification of reception reports is making BBC broadcasts more popular.

THE recent introduction of many new frequencies to the British Broadcasting Corporation overseas transmissions has resulted in new outlets being heard, and stations from 3952 to 26040 kilocycles being tuned at various times of the day and night.

The recent change in policy by the B.B.C. with the issue of verification cards has made listening to London more popular with DX enthusiasts and the list published below is the latest issued by the Corporation.

The recent Geneva telecommunication conference, which discussed all frequencies, is the reason for new frequencies inside the allocated bands, and it is expected that the transmissions from London on the out-of-band frequencies of 9410, 9825, 9915, 12040 and 12095 Kc will be taken from regular schedules.

Reports from readers on B.B.C. broadcasts should be sent to the External Services, Engineering, B.B.C., Bush House, London, W1, England.

Metre Band	Frequencies in kilocycles
75	3952, 3975.
49	5975, 5990, 6010, 6035, 6040, 6050, 6060, 6070, 6080, 6090, 6110, 6125, 6140, 6150, 6165, 6170, 6180, 6195.
41	7110, 7120, 7135, 7150, 7185, 7200, 7210, 7220, 7230, 7250, 7260, 7280, 7320, 7325.
31	9410, 9510, 9525, 9550, 9560, 9570, 9580, 9600, 9625, 9640, 9660, 9675, 9690, 9700, 9710, 9725, 9735, 9750, 9760, 9770, 9825, 9915.
25	11680, 11700, 11705, 11725, 11730, 11750, 11770, 11780, 11790, 11800, 11820, 11840, 11860, 11880, 11890, 11910, 11920, 11930, 11945, 11955, 11960, 11970, 12040, 12095.
19	15070, 15110, 15140, 15180, 15210, 15230, 15260, 15300, 15310, 15360, 15375, 15390, 15400, 15420, 15435, 15447.
16	17700, 17715, 17730, 17740, 17745, 17790, 17810, 17860, 17870, 17890.
13	21470, 21490, 21530, 21550, 21615, 21630, 21640, 21660, 21675, 21710, 21740.
11	25650, 25670, 25720, 25750, 25840, 25920, 26040, 26080.

Cologne transmitter

THE increase to four transmitters in the overseas broadcasts of Deutsche Welle in Cologne, Federal Germany, has enabled the station to extend its broadcasts and it is now on the air almost continuously for 24 hours each day. The schedule now in effect includes a new service to west coast of North America and the extension from three to four frequencies used in most broadcasts.

To the Far East: 5.00 to 8.05 p.m. on 21650, 15275, 11795 Kc.

Arabic Service: 8.30 to 9.00 p.m. on 21650, 17815, 15405 Kc.

Near East: 2.00 to 5.15 a.m. on 15405 and 11795 Kc.

Africa Service: 3.40 to 6.45 a.m. on 17815, 15275 Kc.

America Service: 8.30 to 11.45 a.m. on 11945 and 9735 Kc; 9.30 a.m. to 12.45 p.m. on 11845, 9640 Kc.

North America (west coast): 1.00 to 4.15 p.m. on 11045 and 11795 Kc.

Listening branch

THE formation of a listening group interested in the reception of shortwave and broadcast band stations is announced by members of the Wireless Institute of Australia. This VK2 SWL group now caters for the general listener on the shortwave bands, and readers interested in this and amateur radio listening should get in touch with Gerry Albeck, 175 Union Street, Erskineville, N.S.W.

World radio handbook

THE 14th edition of the internationally known Handbook is now on sale and its pages are full of the information vital to shortwave listening.

Details on all shortwave stations, power, frequency, schedule, address, program details, station personalities and other essential information is published in its 200 pages. The book is packed with accurate information covering all of the broadcasting and television stations throughout the world.

The Handbook is published in Denmark by O. Lund Johansen and its value to the shortwave listener is such that our hobby would be difficult indeed without it. Next to your receiver it is your most valued authority on stations which you tune.

The 1960 edition is available in New Zealand from Arthur Cushen, 212 Earn Street, Invercargill, price 15/6 posted. Australian readers can obtain their copy from Miss Dorothy Sanderson, 23 Elizabeth Street, Malvern, S.E. 4, Melbourne, Victoria, and the price is 17/6 posted. (It is also available from regular technical booksellers.—Editor.)

New Taipeh frequency

THE Broadcasting Corporation of China in its transmission on "The Voice of Free China" has been noted on the new frequency of 17755 Kc. The transmission to Australia and New Zealand from 8.05 to 8.45 p.m. each day is now carried on this channel as well as 7130, 11815 and 15345 Kc. The transmission to North America from Taipeh is also on this frequency for the period 11.30 to 11.45 a.m. and the Taiwan station uses 17755 and 15345 Kc. The station has the callsigns BED58 on 17755 Kc and BED57 on 15345 Kc. The broadcast at 11.30 a.m. is of news and commentary in English, and this transmission is beamed to North America. The broadcast at 8.05 p.m. opens with identification and then music is presented to 8.15 p.m., when a news bulletin is read.

From Sweden

LISTENERS find the broadcasts in English from Radio Sweden in Stockholm of particular interest as each week, during the transmission on Monday, the session of DX News edited by Arne Skoog is presented.

11.30 p.m.-midnight — 15240, 9620 to Far East.

12.45 to 1.15 a.m. — 15240, 9620 to South Asia.

2.15 to 2.45 a.m. — 15240, 11705 to Middle East.

3.45 to 4.15 a.m.—15240 to Africa.

5.45 to 6.15 a.m.—11705 to Africa.

6.30 to 7.00 a.m.—7210 to Europe.

11.45 a.m. to 12.15 p.m.—11810, east coast of North America.

1.15 to 1.45 p.m. — 9620 to North America west coast.

Midnight to 12.30 a.m.—17840 Kc to North America.

FLASHES FROM EVERYWHERE

PRAGUE has added a frequency of 7340 Kc. in its transmission to North America in the afternoons. This channel used from 3.00 to 3.30 p.m. is 7340 Kc., which is outside the normal 41 metre band frequencies. Signals in New Zealand are good and the same program is carried on 9550, 9660, 11740 and 11840 Kc. News follows the opening of the transmission and, on Monday, the program is devoted to musical requests from listeners.

ADEN is now on a revised schedule for its broadcasts on 7170 Kc., and is now operating 4.30 p.m.-8.00 p.m. and 10 p.m. to 7.00 a.m. The station from 4.00 to 7.00 a.m. relays the BBC news, and then takes the Arabic service relay.

KABUL in Afghanistan is reported to have installed new equipment, a West German firm having installed a 50 Kw transmitter to serve Europe, Africa and the Far East. A 10 Kw transmitter has also been installed, as well as emergency equipment. Four directional antennas and two non-directional antennas have been erected and frequencies assigned are 7285 to Europe. Last reported reception for this transmission to Europe was on 7155 Kc. with English from 5.00 to 5.30 a.m. The station has news at 5.05 a.m., when the transmission was

574 Complete set of parts for above Transistor Portable, including Cabinet, Battery, and Instructions. Size 6in x 4in x 2in.

PRINTED CIRCUITS

558. Amplifier Audio Transporta 6 & 7
559 RF Section Transporta 6
562 RF Section Transporta 7
569 Audio & RF Section Transporta 4
568 TV Video Strip R & H

20/- ea. Plus 25% S. Tax.

COIL KITS

560 for Transporta 6	76/-	Plus 25% S. Tax.
563 for Transporta 7	105/-	
570 for Transporta 4	54/-	
571 for TV Video Strip	60/-	

£15/15/0

plus 25% Sales Tax.

DIALS AND KNOBS

453 Dial and Knob 300 pf Gang 10/-
455 Dial and Knob 415 pf Gang 10/-
Above prices are plus 25% Sales Tax.

NOISE SUPPRESSION

Part No.		
11	Aerial Filter Kit	93/4
20	¾ amp Line Filter	31/4
26	¾ amp Line Filter with condensers	60/-
22	5 amp Line Filter with condensers	60/-
24	2 amp Line Filter	37/4
27	2 amp Line Filter with condensers	43/4

Above prices are plus 25% Sales Tax.

TRANSISTOR COILS & IF'S

Part No.		
248	Osc. Coil.	7/
249C	Aer. Coil and Ferrite Rod.	14/
174	Single Tuned IF 455Kc	11/
175	Single Tuned IF 455kc	11/
176	Dble. Tuned IF 455kc Med. Gain	11/
177	Dble. Tuned IF 455kc High Gain	11/
178	Dble. Tuned IF 455kc Low Gain	11/

Above prices are plus 25 p.c. sales ta

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R.C.S. Radio Pty. Ltd.,

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SOLE FACTORY REPRESENTATIVE—VICTORIA—
Distributors Corporation Pty. Ltd., 403 Bourke Street, Melbourne, MU3908.

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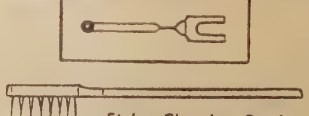
Individually packed, complete with nylon cleaning brush for extra care of records.

METRO-SOUND

MASTER POINT . . . *SAPPHIRE and DIAMOND*

List No. M.S6 For B.S.R. T.C.8M., and
Sapphire Point T.C.8H.
78 R.P.M. only

THIS IS A METRO-SOUND "MASTER POINT" REPLACEMENT STYLUS



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You can buy Metro-Sound Master Point from leading record suppliers.

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35 Bathurst Street, Sydney.
'Phone: 61-6607

heard. A further broadcast to South East Asia from 1.00 to 1.30 a.m. is reported on 11730 Kc.

CYPRUS relay of the BBC programs in Arabic are on the air from Limassol from 1.45 to 3.45 p.m. on 6120, 6170, 9650, 11720 Kc. The service from 9.00 p.m. to 7.00 a.m. is broadcast on 6120, 6170, 6790, 9650 Kc. From 9.00 p.m. to 1.45 a.m. to Iraq and Persian Gulf on 11720. English is relayed 1.30 to 1.45 p.m. and 3.45 to 6.00 p.m. on 6120, 6170, 9650 and 11720 Kc.

JORDAN, with the Hashemite Broadcasting System at Amman on 6020 Kc, is heard from 6.00 to 7.10 a.m. with test programs of western and Arabic recordings. The station announces in English and requests reports to P.O. Box 909, Amman. The new 7500 watt transmitter has been further testing from 5.00 to 9.00 p.m., 11.00 p.m. to 2.00 a.m. and 5.00 to 8.00 a.m.

Notes from readers should be sent to Arthur T. Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

SOUTH KOREA is using 11925 and 15258 Kc. to Western U.S.A. from 3.30 to 4.30 p.m. The program consists of English for the first 30 minutes, and the frequencies replace the old 17745 and 15410 Kc.

KUWAIT is to increase its number of transmitters, according to a letter from the Kuwait Broadcasting Service and this month will operate on 9648 Kc. and on 1130 and 1344 Kc. on the broadcast band. At present the station has been on 4967 between 2.00 and 5.30 a.m.

PHILIPPINES has added a new short-wave relay according to the Japanese Short Wave Club, a listener in that country hearing the broadcasts of DZWS in Manila on 9319 Kc. The station appears to relay this broadcast band transmitter on 1380Kc., and has been heard from 7.00 p.m. to 2.00 a.m. DZWS is operated by the "Manila Times," and the organisation also operates DZMT. Station identification has been heard each 15 minutes. Signals are weak and this off band frequency is naturally subjected to severe morse interference.

INDIA transmissions from Delhi in the External Services of All India Radio, broadcasts to Australia and New Zealand from 8.00 to 9.00 p.m. and uses the frequencies of 21690, 21615, 17795, 17705 and 15105 Kc. from 11.30 p.m. to 12.30 a.m. They are on 21605 and 17705 Kc from 5.45 to 6.45 a.m. broadcasts to Europe are carried on 17790, 15105, 11710, 9590 Kc.

TASHKENT now broadcasts to India and Pakistan in two transmissions in English, which are now on the air at a new time. The broadcasts are from 10.00 to 10.30 p.m., and from midnight to 12.30 a.m. The station uses the same frequencies, 11690 and 7100 Kc.

LIBERIAN station ELWA broadcasting from Monrovia has been noted in the 25 metre band during the afternoons. Missionary programs in French have been broadcast to sign off at 4.45 p.m. but, on Sundays, the transmissions are extended to 5.00 p.m.

(Continued on Page 111)

AWA

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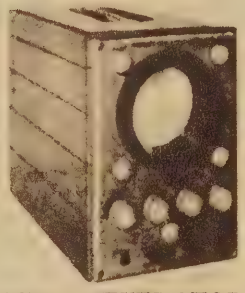

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RF frequency range: TV channels 1 to 10.
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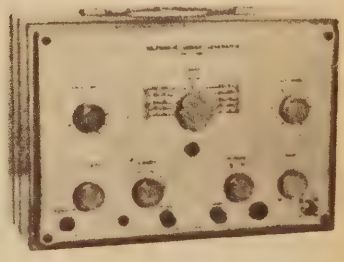

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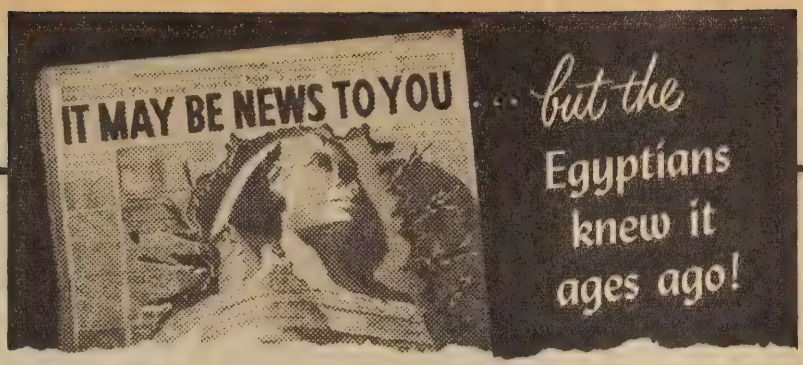

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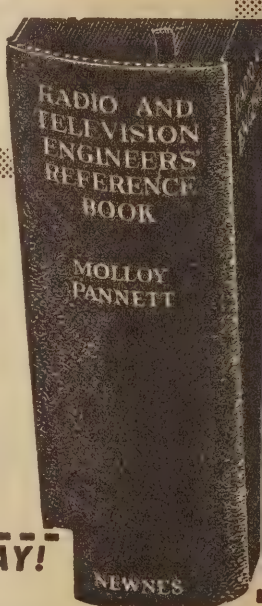

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MAPPING OUTER SPACE

(Continued from Page 7)

In much of their normal program of work the Jodrell Bank scientists are looking a long way ahead of the satellites and space-probes.

In one of the small buildings, for instance, a radio "contour map" of the Andromeda galaxy, some 1½ million light years distant, is being built up from simultaneous traverses across the galaxy on three frequencies.

This is part of a broad study of the position, distance, size, distribution and origin of radio sources both inside our own Milky Way system and in extra-galactic space. Specific investigations include an examination of the galaxies on the frequency of the hydrogen line (a radio emission from neutral hydrogen gas), which enables the motion of hydrogen clouds to be studied.

OTHER PROJECTS

Nearer to earth, a number of ionospheric and other projects on which much work was done during the International Geophysical Year are being continued, with certain changes in emphasis.

The subjects include the scintillation or twinkling of radio stars, the drift of meteor trails in the E region (about 100 km altitude), a monitoring of solar phenomena on three frequencies, and radar studies of aurorae and of the ionised trails of meteors entering the atmosphere.

In most of these programs the massive steerable radio telescope plays an important part. Its time is allocated to the various projects according to a prearranged schedule, and the instrument normally works a 24-hour day (including maintenance and aerial changing between experiments). At the time of the author's visit to Jodrell Bank recently a 12-hour period of measuring the angular diameter of radio sources with the bowl in the fixed position (i.e., making a transit with the earth's revolution) was followed by a survey of one discreet source.

From the control room in the centre of the low brick building about 200 yards from the telescope, the movement of the instrument is electronically controlled.

Steering instructions are determined by an electronic analogue computer which solves the 14 different equations needed to give accurate control of the instrument over all parts of the sky.

AUTOMATIC CONTROL

To keep the telescope automatically trained on a star, for example, seven of these equations are used to translate the position and movement of the star, as given by the celestial co-ordinates of right ascension and declination, into terms of telescope azimuth and elevation.

The remaining seven equations deal with the case of a scan along or across the Milky Way, for which the frame of reference is that of galactic latitude and longitude, which again must be expressed as a steering instruction to the telescope in terms of azimuth and elevation.

Amplified signals determine the speed of the various electric motors which control the movement of the telescope through two Ward Leonard motor generator sets housed just above the central pivot bearing.

The steering of the telescope is carried out from the main controller's console, where a safety interlock system gives visual warning of the position of men who may be working on the telescope structure.

About six feet away on each side of the control desk is a bank of 15 large dials. Those on the right of the controller show him the actual and computed positions of the telescope (elevation and azimuth); while on the left the dials indicate celestial co-ordinates (right ascension and declination) and galactic co-ordinates (galactic latitude and longitude).

This information is accurate to at least one minute of arc; and universal and sidereal time are also displayed.

New achievements at Jodrell Bank this year have included the transmission of voice messages to Cambridge, Massachusetts, via the moon; and the switching off and on of the telemetry transmitters in the "paddlewheel" satellite while in orbit by the S.T.L. team.

In the near future it is hoped to reflect a radar echo from Venus.

To visit the skilled young practitioners of the young science of radio astronomy at Jodrell Bank, and to hear about their work, is to realise the incredibly vast new realm of knowledge which their thinking and experimental techniques are making possible.

Radio astronomy already forms an important part of astronautics today, and Prof. Lovell himself has indicated the probable development over the next 10 years.

"I believe the next decade in space research will see developments in astronomical work which were inconceivable only a short time ago," he said.

ABOVE ATMOSPHERE

"During this period one can confidently expect that both radio and optical telescopes will be carried on earth satellites so that the universe can be studied from above the interfering regions of Earth's atmosphere.

"One can even hope that remotely controlled telescopes may be operated from the moon within this period.

"In connection with space probes, it seems clear that such vehicles will be able to approach and possibly sample the atmospheres and surfaces of some of the planets. The contributions which can be expected to result to our knowledge of the conditions and evolution of the solar system are at present almost incalculable."

STEREOPHONIC EQUIPMENT

POINTERS ON BUYING

BE CAREFUL OF YOUR FRIENDS

Your friend may have read a few more advertisements than you have. This does not make him an authority. Remain sceptical when he describes the X speaker as the only possible choice and has never heard it.

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One well-known speaker has a useful frequency range of 30-14,000 cycles in England and 20-24,000 cycles in Ameria. One popular stereo cartridge has a frequency range of 40-12,000 cycles in England and 30-24,000 cycles in Australia.

DON'T BUY ON NAME ALONE

Remember there is as much difference between a 8in and a 12in in some of the good speakers as there is between a G.M. Holden and a G.M. Cadillac.

DON'T SPEND TOO MUCH ON YOUR AMPLIFIER

Though there is a difference between a good and a superlative amplifier, there is a far greater difference between a good and a superlative speaker.

DON'T TEST THE EQUIPMENT SOLELY ON DEMONSTRATION RECORDS

The number of persons who can tell the difference between a distorted and an undistorted train is very limited.

DON'T TRY TO BUY THE "BEST"

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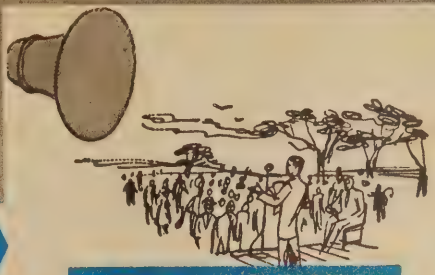

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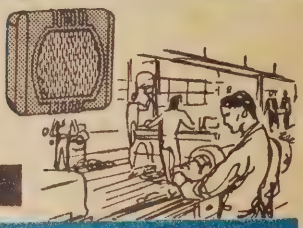

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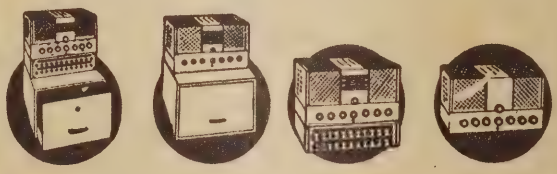

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ANSWERS TO CORRESPONDENTS

P.T. (Toowoomba, Q.) submits a tran-tor circuit based on one published in April, 1957, issue, and which he ggests might be of use to other read-

A. Many thanks for the contribution. T. We fear, however, that it would t compare with the performance pos-le with some of our later circuits de-ned around more recent transistor pes, particularly where regeneration n be employed.

R.J. (Zillmere, Q.) is another of several aders who has written to comment on Serviceman's article in the October, 59, issue. He points out that the loca-n of a reflecting surface causing a ' ghost will lie on an elliptical path awn around the transmitter and re-ver.

A.: Many thanks for your letter and mments, R.J. This subject has been alt with in detail in the Argument page d so will not duplicate the discussion re.

E.L. (Salisbury, Q.), prompted by the icle in the November issue on Check-Power Output, sends us a descrip-n of a similar but rather more elabor-resistance box he uses for his own rk. He also asks for some clarifica-n regarding tone control circuits.

A.: Many thanks for the circuit details, L., and we will file this for possible e in the "Reader Built It" section. We e a little puzzled over your tone con-l problem, since one of the circuits u present appears incomplete. The ner two are only slightly different. In e the capacitor and resistor are in ries and the amount of resistance is riable and in the other the capacitance tapped across the resistor. The latter necessary when the D.C. circuit must preserved. There is no real differ-ce in the operation of the circuits, wever. The capacitor is chosen to esent a low reactance at the higher dio frequencies. These are bypassed rough it in greater proportion as the nount of resistance in series with the pacitor is made smaller.

S.E.C. (Primbee, N.S.W.) sends a de-ription of a fluorescent lighting cir-it using a discarded Ford coil and a volt accumulator. He inquires ether there is any risk of X-ray radi-ion from such a set-up due to the gh voltage from the spark coil.

A. Thanks for the contribution, E.C., and we will keep this for pos-ble use in the Reader Built It page. e doubt whether there is much risk of -ray radiation, since the voltage across e tube probably is no higher, if as gh, as when normally used. Although le to deliver very high voltages across air gap, the regulation of the coil uld be very poor, and, when loaded the tube, would drop to a low value.

P.G.H. (Sandringham, Vic.) writes to ll us that a fault in a Transporta Six, nich he recently built, has now been red. He goes on to point out that he hieved this by pulling the set down d rebuilding it, contrary to the ideas expressed by the Serviceman in a recent article.

A.: Glad to hear that the set is now O.K., P.G.H. While you seem to be one of the very lucky ones, we feel that we must agree with the Serviceman. Such luck as yours is rare, plus the fact that the exact cause of the trouble is still unknown. However, it seems that a wiring error must have been responsible, since (we assume) the original parts were used.

E.T. (Gosnells, W.A.) wants to know if we can help in the matter of radio control for models, since the data available from English and American text books is not always suitable for Australian conditions.

A.: We did publish a series of contributed articles on this subject in the September, October, November, 1950, issues, and you may care to refer to these at your nearest large public library. Otherwise we have had no chance to produce anything in our own workshop, though we have this in mind just as soon as we can devote the necessary time to it.

T.C. (Clayfield, Qld.) is interested in using fluorescent tubes, which have faulty filaments.

A.: The "Reader Built It" item in the January issue may be of interest, although we have not actually checked the scheme ourselves.

R.H. (Padstow, Sydney) has been window shopping and has noticed some crystal receivers with car-type aerials and others with clips for attaching to "telephone dials or other small metallic objects acting as an aerial." He would like to know how this is possible when crystal sets usually require long aerials.

A.: We don't know the particular sets "A.H." mentions, but it is possible that some of them may have been one transistor sets, in which case a slightly smaller aerial may be required. In any case, there are no absolute rules applying to crystal sets since so much depends on the location. If the set is operated fairly close to a station quite a small aerial may be sufficient. A good earth, of course, will help immensely. In general, however, for comfortable reception of several stations a good high aerial will be required.

G.S. (Collie, W.A.) writes to say that he has a commercial, seven transistor, portable receiver and wishes to connect an external aerial. Can we help him?

A.: Since we are not familiar with the specific model he owns, we cannot offer more than general advice. Usually it is satisfactory to wind a few turns of some light gauge wire on to the ferrite rod near the main tuning coil. One end is earthed and the other goes to the external aerial. The exact position of this winding and the exact number of turns is best found by trial and error.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor,, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

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2 X2	6/9	7 A6	5/	1626	5/
6 AC7	2/9	7 C7	1/11	1629	7/6
6 AG5	6/9	12 A6	7/11	1632	12/6
6 C4	5/	12 C8	10/6	1638	7/6
6 C3	7/6	12 H6	7/11	1639	7/6
6 G6	12/6	12 J5	10/6	2051	15/
6 H6	1/6	12 K8	12/6	7193	1/6
6 J7	4/9	12 SC7	12/6	AV11	1/11
6 K7	3/11	12 SH7	10/6	CV66	4/6
6 K8	6/9	12 SJ7	9/6	EF39	3/6
6 L7	12/6	12 SK7	10/6	EF50	1/6
6 N7	9/6	12 SR7	4/6	Sockets	2/
6 R7	12/6	217 C	10/	EL32	7/6
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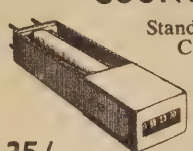

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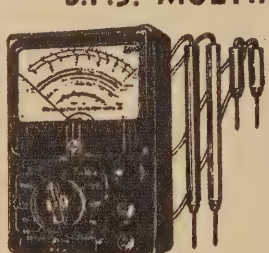

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"ACOS" GP 66/3 crystal pickup for standard and microgroove records. Incorporating a new diecast arm finished in grey hammertone. Replacement styli: standard SJ.1, microgroove SJ.2.

Packing and postage 4/

WIDE ANGLE LENS

"Delrama" wide-angle lenses for 8mm or 16mm movie cameras. Brand new, perfect condition. One lens only needed for both taking and projecting. Normal price over £40.

£12/10/-

Postage and Packing 3/6.

METERS

0-1 milliamp 2½in face (as illustrated)	59/6
0-1 milliamp 1½in face (as illustrated)	45/
0-50 volt A.C./D.C. 3 3/8in round	55/
0-250 volt A.C./D.C. 3 3/8in round	70/
0-1 amp A.C./D.C. 3 3/8in round	55/
0-3 amp A.C./D.C. 3 3/8in round	55/
0-5 amp A.C./D.C. 3 3/8in round	55/
0-20 amp A.C./D.C. 3 3/8in round	55/
0-30 amp D.C. 3 3/8in round	55/
0-50 amp A.C./D.C. 3 3/8in round	55/
0-100 amp A.C/D.C. 3 3/8in round	55/
0-1 milliamp 1½in square	37/6
0-50 microamp 2 1/3in square	75/
0-100 milliamp 1½in square	37/6

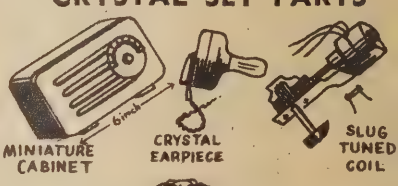
TEST PRODS

Imported test prods and leads, fitted with 1/8in banana plugs to fit the latest instruments.

12/6

Postage and Packing 1/6.

CRYSTAL SET PARTS



Crystal Earpiece, latest alternative to headphones, 10 Headphones, high impedance, 27 6. Miniature Cabine 7/6. Slug-tuned coil, latest idea from overseas, cor plete with knob, condenser with circuit, 16/6. G manium Diode, 3/6. Aerial Wire, 5/. Terminals f earth and aerial, 1/ each.

Postage 2/6 per part, or 7/6 a full set.

Packing and Postage 1/6

BOOKS! BOOKS!

Book No. 86 Midget Radio Construction	5
Book No. 99 One Valve Receivers	2
Book No. 101 Two Valve Receivers	2
Book No. 102 40 Circuits Using Diodes	4
Book No. 106 Radio Circuits Handbook	3
Book No. 123 The Beginner's Push-Pull Amplifier	2
Book No. 115 Constructors' Handbook of Germanium Circuits	3
Book No. 126 The Boys' Book of Crystal Sets	3
Book No. 133 Radio Controlled Models	7
Book No. 138 How to Make TV Aerials	3
Book No. 150 Practical Radio Inside Out	5

Packing and postage, 1/6.

SPOTLIGHTS

Genuine Lucas Lamps with 2 spare globes, **only 50/.** Complete in case with morse key, filters and mounting spike. **ONLY 62/6.**

3ft tripods, non telescopic, **25/.**

Postage and Packing 8/6.

FLEXITOOLS

Flexitool. Can be powered from a stationary motor, or electric drill. 44in long with a a ¼in chuck. Ideal for where a drill is hard to fit or handle.

£4/15/-

Postage and Packing 5/.

POWER SUPPLY

(Continued from Page 65)

ble values which will spread the 0-300 ange nicely across the rotation of the ontrol potentiometer.

Whilst the carbon variety should be atisfactory for most applications, there nay be some situations where it is felt nat a more robust pot. will be required. The generally available wirewound pots sually do not exceed 10K or 20K ohms nd their use in this circuit would neces- itate a high standing current through ne control divider.

However, one manufacturer at least nakes special wirewound pots up to uite a high value and one of these ould be used. (Naunton, Melbourne.)

We have incorporated a standard neteringcircuit in the output of the upply. This may or may not be re- uired in every case but it is convenient.

Our construction, and the lay-out we ave employed, is fairly obvious from he photographs. One important point o watch is the placement of the ampli- er valve. It can be susceptible to hum nd is best mounted well away from the ransformer. Otherwise standard power upply construction is employed.

Another point is that 807 valves, par- icularly parallel-connected 807s, are rone to oscillation. The grid stopper re- istors shown in the circuit are a pre- aution against this tendency. Oscillation roduces an initial bias on the 807 grids nd may prevent the impedance of the alves from being reduced sufficiently to chieve the requisite output volts.

It is sometimes convenient to have he negative output, as well as the posi- ive, isolated from the earth line. Then he supply may be connected into an xisting system in any polarity.

To this end, all the "earthy" returns re brought out to the negative output erminal and the mains earth, which is onnected to the chassis, is brought out o a separate terminal adjacent to the egative output. The two may be strap- ed together, when required.

HUM PROBLEM?

If any hum troubles are experienced ecause of this method of wiring, a 1.0 nfd, 600 volt working, capacitor con- ected between the negative output and hassis will normally cure it. The loca- ion of this component may have some earing on its effectiveness.

For a variable bias supply, which is ome times convenient, we have tapped ff some of the stabilised voltage from he VR tubes. This is the purpose of he divider network at the cathode of he 6SJ7. It is not advisable to draw ny current from this source.

The standard instrument case, which ve have used so often before, was too mall to accommodate the supply, but ve found that Messrs R. H. Oxford and Co., of Redfern, Sydney, had in stock a arger case measuring 15in x 10in x 8in leep. This is the one shown in the hotographs and it accommodates the upply admirably.

We plan to prepare a blueprint of he chassis lay-out and, if the demand varrants it, the chassis may be made vailable with the case.

The two holes at the left of the case re for an octal and a five-pin valve ocket. For certain pieces of apparatus, vhich are used in connection with the upply on frequent occasions, it is more onvenient to wire their power leads to plug rather than for terminals.

TRUVOX TAPE DECKS MK.IV.

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NOW SUPERSEDED, BRAND NEW AND BOXED **£38**
incl. tax, plus freight.

FOUR (4) WITH COUNTERS. **£41**
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281 La TROBE STREET, MELBOURNE. C.1.

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For use in Voltage Doubling Circuits

TYPE	PRIMARY	SEC.	DIODES	OUTPUT	L.T.
PTD-1	220-240-260v	185v	0A-214	465v-200 mA	2 x 6.3v /3.5A
PTD-2	220-240-260v	130v	0A-210	310v-200 mA	2 x 6.3v /3.5A

PTD-1 DESIGNED FOR USE IN MULLARD 20W AMPLIFIER

PTD-2 DESIGNED FOR USE IN R.T. & H. 10W STEREO AMPLIFIER

(Refer to December issue of R. T. & H. page 65 for Circuit and discussion of Voltage Doubling Power Supplies.)

Other Transformers in this range, with lower ratings, are in the design stages and will be announced later.

◆

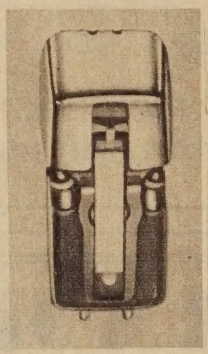
Available from all leading distributors—or from

BRAMCO RADIO COMPONENTS

BOX 39 P.O. WALLSEND, N.S.W.

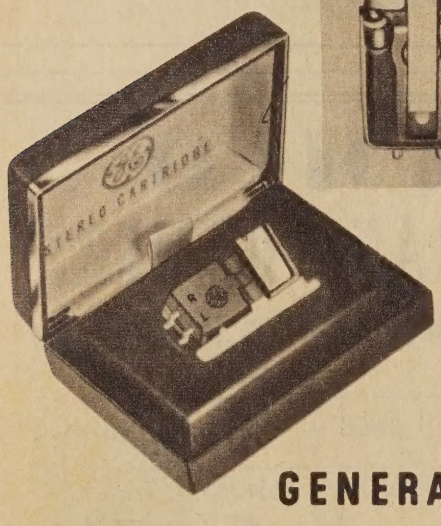
General Electric HI FI

VR-22 stereophonic magnetic variable reluctance high fidelity cartridges



MODEL VR-225
(With .5 mil diamond stylus for professional quality tone arms)

MODEL VR-227
(With .7 mil diamond stylus, for professional arms and record-changers)



Outstanding in All Four Areas of Stereo Cartridge Performance . . .

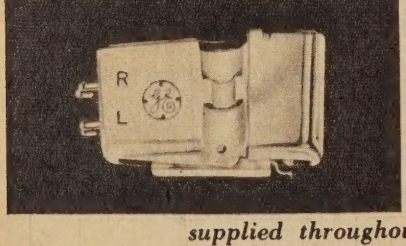
- Full, Flat Frequency Response, 20 Through 20,000 Cycles plus or minus 3 db (Model VR-225).
- Unusually High and Consistent Channel Separation, up to 28 db.
- New Stylus Assembly for Optimum Compliance and Precision Tracking. New Triple Shielding for Positive Hum Suppression.

GENERAL ELECTRIC

VR-227 Red Body. .7 mil. diamond stylus, £18, including tax.

VR-225 White body. .5 mil. diamond stylus. Available March. Price to be announced.

Due to unprecedented demand for the VR-225 overseas, our supplies have not yet arrived. However, we will be in the happy position to fulfil all outstanding orders for this cartridge by the end of this month. Supplies of the NEW General Electric "STEREO CLASSIC" compatible stereo and monaural tone arm model TM-2G will also be available.



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Fidelity AE Audio Engineers PTY. LTD.

NOW AVAILABLE FROM YOUR HI-FI DEALER

COMMERCE—AND A PACK OF CARDS

(Continued from Page 15)

machine provided with 100 print wheels and 100 counter wheels. Each print wheel carries a complete range of alphabetical and numerical characters and provision is made for the addition of additional symbols.

Groups of wheels can be linked to provide individual counters of variable capacity.

These wheels are turned electrically. This is achieved basically by sensing brushes which make contact through the punch holes in the card in a similar manner to the sorting machine.

CONTROL PANEL

In order to link up the wheels in various groups and to provide circuits from the sensing brushes to the various internal parts of the machine, a control panel is used. This is shown in an illustration.

The panels range in various sizes, the largest of which contain 2,400 pluggable holes, in a bakelite panel.

To gain some idea of the operation of the panel, one can draw an analogy with a manually operated telephone switchboard.

Imagine the card sensing brushes to be a number of outside subscribers. There are also a number of subscribers connected to the manual exchange represented by the print wheels, counter wheels and so on.

The control panel is the switchboard where the operator can push a plug into a hole and direct a message or impulse from the card sensing station (incoming call) to the print wheels and so on.

Thus cards containing the basic information and which have been assembled in some logical sequence by the sorter are fed continuously into the tabulator sensing station, where the value and significance of each punched hole is read at the rate of up to 170 cards per minute.

TIMED IMPULSES

The timed electrical impulses originating at the sensing station are directed selectively to the different operating components of the machine.

When we say directed selectively we mean that the operator, by means of the control panel, can prearrange the whole program of the machine.

Printed paper diagrams of the control panel are previously drawn up by the operator showing which holes to plug with the wires. This is applied to the control panel and the wires plugged into the various holes required. When the wiring is completed, it looks very like the inside of a telephone switchboard.

The panel is inserted into the machine where it then makes contact with the various terminals in the panel aperture.

A single panel or a series of panels can be inserted into the machine to control the various functions which are as follow: Selection of information to be extracted from the cards and its destination either directly to the tabulator print unit or to counters; addition and subtraction and the "rolling" of quantities or values from one counter to another

ting totals and balances, and their tioning, as well as printing of identi- tion detail and descriptions both abetic and numeric; timing and uence of all operations.

rewired panels for various operations e it possible to quickly change the chine from one operation to another. Needless to say, the internal wiring a tabulator is very complicated, there g 16 miles of wire used in the vari- circuits.

The operator, however, is not bothered n this. All he is concerned about is wiring up of the control panel to his requirements of the moment.

The tabulator will print the informa- on the card in a form indistinguish- e from hand-typed forms. It will t invoices, monthly statements, led- cards and so on.

All the cards relating to the transac- ns for the month are placed in the chine and the invoices come out in ontinuous strip, ready to be separated put into the envelope.

THER MACHINES

Space does not permit of a description other machines used in punched-card tems, such as the Interpreter, which turn a punched card into a visual ex by printing descriptions, names and dresses, etc., on the top of the card.

Or the collating machine, which col- ts the same data from cards and rges them together, or selects cards taining particular information, etc.

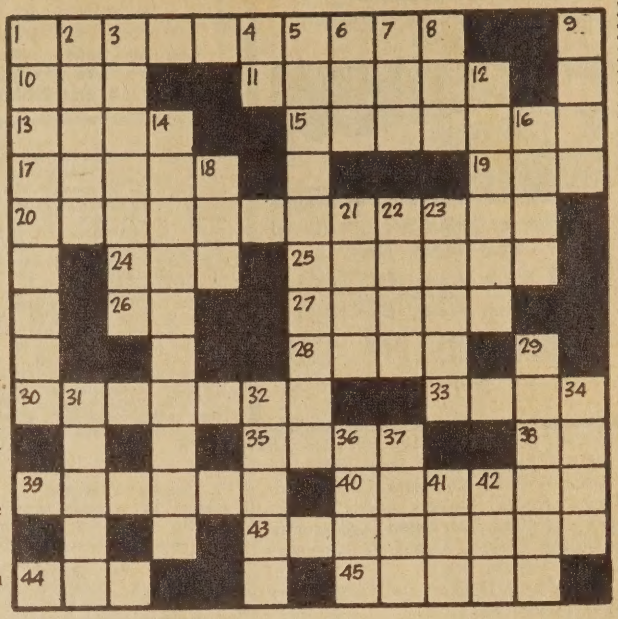
Then there is the computing machine, "electronic brain," which performs nplicated mathematical calculations at redible speed and delivers the results printed form.

Mention must be made of the process led "mark sensing." This is a pro- s which can replace manual punching der certain conditions.

Space is provided on the card for the rking by a special graphite pencil, of ta which is to be punched on the card. ese graphite marks act as conductors relays which operate punches. Thus machine senses the marks and nches the corresponding information another part of the card ready for ocessing by the sorter, tabulator and on.

These cards are useful for distribution the various heads of departments to rk stock balances, machine times and on directly on the card, thus saving nsiderable time in the office.

THE R., TV & H. CROSSWORD No. 71



ACROSS

1. Addition of audio to carrier.
10. Removed by "getter."
11. Symptom of audio instability.
13. Fluorescence.
15. Becomes less harsh.
17. Not in all time.
19. Grain fodder.
20. Thermionic diode operation.
24. Negative temperature coefficient (abbrev.)
25. Wooden boards.
26. Depart.
27. Manipulative forelimb extremities.
28. Semi-circular recess of a church.
30. Indentations.
33. Expressing unfair cost.
35. Stage scenes.
38. Field emission (abbrev.)
39. Expressing good humour.
40. In a grating manner.
43. Materials capable of producing electrons.
44. High value card.
45. Troublesome parasites.

DOWN

1. Micro-wave oscillator valve.
2. Lubricated.
3. Moving sheep.
4. Amplified signal (abbrev.)
5. Industrial power supply system.
6. Institution of Radio Engineers. (Abbrev.)
7. Liquid fuel.
8. Normal electron energy (abbrev.)
9. In a fair manner.
12. Raps.
14. Potential difference standard (two words).
16. Knits lace edging.
18. Gigantic legendary bird.
21. Aircraft control device.
22. Air circulators.
23. Terminated.
29. Portions of switch.
31. Linear resistance to current flow.
32. German city.
34. Communists (colloq.)
36. Safety switch.
37. Satisfy the appetite of.
41. Standard Time Signals. (Abbrev.)
42. Domestic animal.

Solution and further crossword next month

ON SHORTWAVE

(Continued from Page 103)

HANOI, in North Vietnam, has a ses- n of English news at dictation speed, d this is being heard on 11,840 Kc. m 6.15 to 6.55 p.m. The signal was so observed on 9,840 Kc., when trans- ission was heard in North America.

OMDURMAN, in the Sudan, is re- rted to be using 11,855 Kc. in the ansmission when opening at 2.15 p.m. 3 a.m., and again from 5 a.m. to n off at 7 a.m. The programs are Arabic, but identification is given in nglish before sign-off time.

BRAZZAVILLE transmissions in Eng- sh appear to have been revised and e station has been logged with Eng- h news at 3 a.m., when using 11,725 d 9,545 Kc.

WINDWARD ISLAND station at St. eorge, in Grenada, is heard in North America at 8 a.m. on 15,082 and 5,010 Kc. The station at this hour carries a six-minute news bulletin from Montreal in the C.B.C.'s Latin American service.

HONDURAS station HRBF, in Tegucipalpa, is using 9,872 Kc.; the station was heard at 10.30 p.m.

ISRAEL is reported to have made slight frequency alterations and is now using 9,727 Kc. for its transmission at 6.30 a.m., when English news is carried. The station is also using 9,009 Kc., which is normally the stronger signal.

TANGANYIKA has appeared on 4,785 Kc. with a program in English and the frequency replaces the 4,845 Kc. channel. The station announces as "This is the second service of the Tanganyika Broadcasting Service Dar es Salaam," and has been heard at 4 a.m.

Last month's solution

T	H	E	R	M	I	O	N	I	C		P	
A	E	R	I	A	L	S		N	E	P	E	R
P	A	R	C	E	L	S		T	R	U	R	O
P	R	I	E	S		E		E	E	L		B
E		N			C	O	R	R	A	L		U
D	I	G	I	T		U		C	L	I	P	S
W			R	U	S	S	I	A		N	O	T
I	N	T	O	N	E			R	A	G	E	
N		I	N	E	R	T		R				B
D	I	S	C		I		P	I	E	R	C	E
I		S	O	F	A	S		E	X	I	L	E
N		U	R	A	L	S		R	I	P	E	N
G	R	E	E	T		E			T		O	

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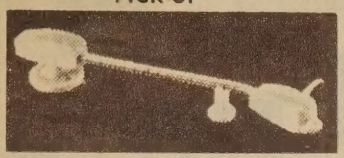
AWA RONETTE

Wide Range FONOFLUID PICK-UP



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FF3 16in Arm. £7/16/11

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SELL: A.R.C. mod. osc. multimeter, sig. tracer, £25. **A. Dobbs, 580 Lutwyche Rd., Lutwyche, Brisbane.**

SELL: AR8 powerful 12 valve all wave receiver. 240v app. Cost £34. Must sell, as new, £18. **54 Gungah Bay Rd., Oatley, N.S.W. LU1705.**

SELL: BC221, complete, £40. 32V240VAC100W inverter, as new, £18. 64UF700VW, £4. 12V-360V tranny (fits 122), £1. 4 X Tals 3525KCS 7000KCS, 30/ ea., other parts. **12 Andersons Rd., Hawthorn, Melbourne.**

SELL: Communications Receiver, ex A.W.A., 6 band, 48-26 Mc/s, B.F.O., x'tal Filter, power supply level meter, £25. **C. Foster, 855 Osborne Rd., Blacktown, N.S.W. Phone B1222.**

SELL: H.R.O. receiver 180 k/c to 30 m/cs seven plug-in coils bandspread ham bands, complete, £43. Car radio, 6 volt, £6. 32 volt to 240 volt vibrator AC power supply, £5. **35 Murray Rd., Cheltenham, N.S.W WM4245.**

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WANTED: RCA 77 DX velocity microphone, in good order.
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